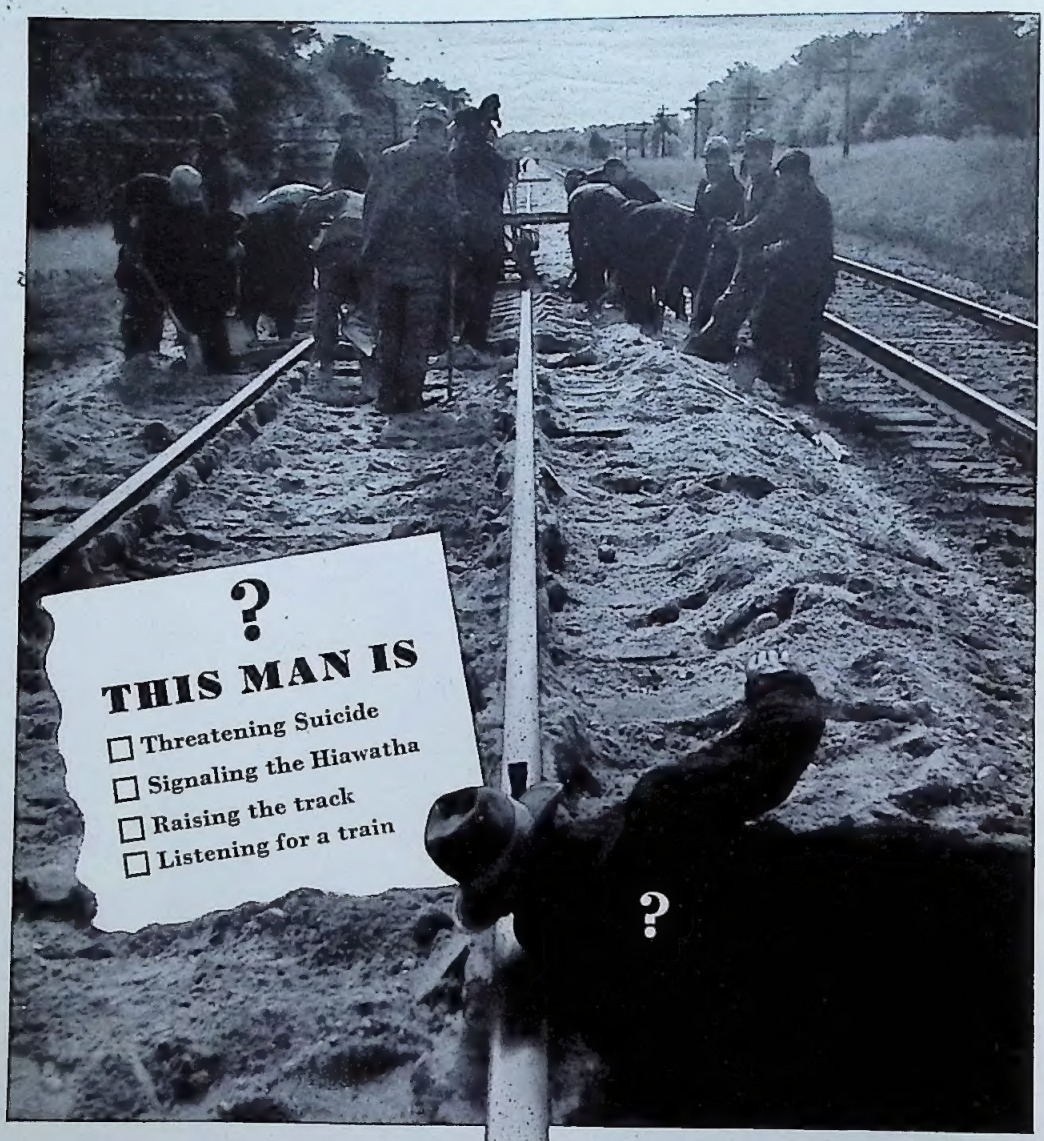
Trains

25¢

April, 1946



HE is a track raiser taking a sight necessary for accurately *raising track* during a ballasting job on the Milwaukee Road. This stretch of double track is rated by engineers tops for high speed, heavy-duty operation. It cushions the HIAWATHAS and a great fleet of super-speed trains running on faster than mile-a-minute schedules between Chicago, Milwaukee and the Twin Cities. Properly cared for, a well built road bed like this one improves with age. The Milwaukee Road program of track improvement and maintenance never stops. As the track expert pictured above with his head to the rail said, "We make 'em as smooth as a ballroom and as solid as Gibraltar."

THE *Milwaukee* ROAD

FIRST WITH THE FINEST

Trains

Volume 6, Number 6

April 1946

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Celebrating the 100th Anniversary of the Pennsylvania RR. Chartered April 13, 1846.

"The railroad is a monster. His feet are dipped into the navigable seas and his many arms reach into the uplands. His fingers clutch the treasures of the hills—coal, iron, timber. His busy hands touch the broad prairies of corn, wheat, fruits. With ceaseless activity he brings the raw material that it may be made into the finished. He fills the ships that sail the seas. He brings the remote town in quick touch with the busy city. He stimulates life. He makes life." — Edward Hungerford in "The Modern Railroad."

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$64 QUESTION BRINGS A Billion Dollar Answer

Coming out of the war—in which they were called upon to carry more than 90 per cent of the military transportation load—the railroads are being asked this question:

"What are you going to do about peacetime equipment and services?"

And here's the answer for 1946:

A billion dollars' worth of new passenger and freight cars, new locomotives, new and heavier steel rail, new operating facilities, new equipment, materials and supplies of all sorts.

This means new ideas in cars—whole new trains—providing the utmost in safety, comfort, and luxury. New motive power. Better tracks and roadbeds. New standards of dependable, all-season freight service.

For the future, the answer is to be found in a continuation of railroad research for better transportation service, carried on more actively and on a broader front than ever before.

And all of it—not just the cars and engines, but the roadbeds upon which they run and the fixed facilities they use—is paid for with railroad money—no government subsidy—no federal, state, or municipal aid—no money from the taxpayers.

Operating on this self-supporting business basis, the railroads provide America with the greater part of the transportation upon which its future prosperity depends—at a cost averaging well below that of any comparable service anywhere in the world.

AMERICAN RAILROADS

IN PARTNERSHIP WITH ALL AMERICA

Report Emphasizes Critical Factors

The recently released Annual Report for the 99th year of the Pennsylvania Railroad emphasizes three important factors in the railroad situation which have a substantial bearing on the kind of public service the railroads would like to perform. One is the trend of business; volume is decreasing now that the war is over, costs are increasing. Another is taxes; railroads must spend over half the earnings after deducting wages and prior costs on taxes. The third factor is the attempts of the Department of Justice to interfere with the long existing scheme of regulation of railroad rates and other factors previously controlled by Congress through the Interstate Commerce Commission in co-operation with railroad management; Congress may pass the Bulwinkle Bill, H.R. 2536, to restrain such Department of Justice interference.

The report goes on in some detail about this and other matters of extreme importance to the entire industry and includes such pertinent remarks as "Large expenditures must be made for rehabilitation of the railroads. All of these necessities will require money in large amounts. Money requires credit, and the credit of the company is very much affected by the rates at which the business is carried . . . airways, highways, and waterways will be expanded at government expense, while all of the improvements for the railroads will be privately financed. . . . Not only social but political unrest is now prevalent. Labor organizations challenge the leadership which labor has been following for years. Rivalry between labor organizations . . . has led to varied and fanciful demands upon all of those who have to do with labor. . . . Much has been said about national transportation system planning, but little has been done about it."

The report, in outlining the year's improvements, mentions new car retarder installations at Enola; double track east and west of Greenfield, Ind.; third track and signals added between Crestline and Bucyrus, O.; and 75 Pennsylvania type locomotives, nearly half of which were already delivered. The name Pennsylvania type, for four-cylinder engines with either four or five driving axles, is used freely in the report.

New UP Coaches

The Union Pacific has ordered 65 aluminum superstructure passenger cars from American Car & Foundry. Cost will run approximately $6 million. Eight lunch counter diners will have soda fountains, tables for 40, and counters. Nine club lounge cars will have showers, barber shops and lounge seats. Six dormitory club cars will have bar and lounge seats, while three café lounge cars will include 24 seats for dining, 24 lounge seats and an eight seat card section.

Other cars in the order are 13 48-passenger diners, 11 baggage cars, three 60-foot mail cars, three 30-foot mail cars, and nine baggage-dormitory cars. Delivery will begin late this year. The UP has accepted delivery from Pullman of 100 lightweight sleepers already in service on the *City* streamliners, and further new equipment is being considered.

All Sleeper Service Restored

Those who are planning trips this summer on trains, will be encouraged to find Pullman accommodations close to normal.

On March 15, the Office of Defense Transportation withdrew its wartime order on sleeping car operation, effective since July 15, 1945. The restrictions and limitations on advance reservations in sleeping cars and coaches have already been removed by the majority of the railroads. The order was originally established due to the enormous amount of troop movement and shortage of troop sleepers. Since early February, this has been eased considerably by the completion of most of an order of 1200 troop sleeping cars, and the Army is now able to handle the brunt of troop travel.

The order saved 895 extra cars for military use. 334 cars were returned to civilian use February 15, 372 on March 1, and the balance on March 15. Seventy-four Pullman cars were restored to 19 cities on the Pennsylvania Railroad alone on March 1 and service was fully restored on March 15 involving 13 cities 250 miles, or less, distant. The heavily traveled *Edison* between New York and Washington renewed Pullman car service on March 16 after being absent from public timetables since July. New York, New Haven & Hartford Railroad will also return sleeping car service to the very popular *Owl* and *Narragansett* which run between New York and Boston.

Most of the established routes under 250 miles that were affected by the Government limit have had their sleeper service restored. The days of standing all night in aisles, and sleeping in smoking rooms are mostly over, but railroad officials are expecting their heaviest summer travel this year. The situation may be quite acute, but it will not reach the wartime stage of congestion.

Colonel Ragsdale Dies

Colonel E. J. W. Ragsdale, chief engineer of the railway division of the Edward G. Budd Manufacturing Company, died at the age of 61 of a heart attack. He was one of the foremost thinkers and planners on modern railroad passenger transportation and had been instrumental in the new Budd postwar designs as well as the original entry of the company into the stainless steel railroad passenger car field.

Extensive travels on American railroads, as much as 50,000 miles a year, together with a brilliant engineering mind and a flair for original ideas, enabled him to contribute many new ideas not just in car engineering but in the whole concept of the function and possibilities of the railroad as a passenger carrier.

What, No Railroads?

Before he became president of the United States, Harry S. Truman, speaking in the United States Senate of the ills of the railroads, said, "Railroads exist for one purpose only, to transport passengers

and freight around the country. It is a sales proposition, and if they cannot sell transportation to the country and their competitors can, the railroads will go out of business just as old river packets did."

But whether the railroads allow themselves to be outsold on transportation, or whether they lose high rate business through no fault of their own, but merely because an unsuspecting public allows subsidized competitors to take it away when by basic economics it should go by rail, the country would be in a bad way without railroads. Suppose all the country's freight went by truck instead of by rail. Suppose we loaded those 15,000-ton ore trains and the long C&O and N&W coal trains into trucks with a driver and helper per each. Suppose we put into trucks not only the high rate traffic, the short hauls, the less than carload lots, but also the heavy bulk traffic the railroads are best adapted to handle. Then we should see how short-sighted it is not to use every means to assure our country of adequate rail facilities, for the total transportation bill of the United States would be increased some $20 billion, and our standard of living would be reduced by more than 10 per cent.

Radar for Railroads?

The use of radar to prevent railroad accidents is not practicable with any equipment so far known to the radio industry, according to W. P. Hilliard, General Manager of the Bendix Radio Division of Bendix Aviation Corporation, large wartime suppliers of radar to the army and navy. Mr. Hilliard deplored the optimistic forecasts of feature writers and broadcasters in visualizing the use in the near future of radar sets which would enable engineers to "see" a stalled train or obstruction on the tracks.

"The success obtained with radar in locating airplanes and surface vessels has endowed it in the public mind with magical properties which the facts simply do not bear out," said Mr. Hilliard. "While further research and development may eventually result in improvements which will solve the problems involved in 'seeing' around curves or behind hills, at the present time techniques and equipment have not advanced to a point where satisfactory results can be expected from the use of train-radar.

In contrast to radar, Mr. Hilliard foresaw an early general adoption of very high frequency radio by railroads for voice communication between trains and dispatchers and between engines and cabooses on the same train. He pointed out, however, that the principal advantages of radio to the railroads would be in effecting speedier and more economical operation, and stressed the fact that while the very high frequency radio would contribute to safety through the use of the recently announced Bendix "Slowtone" warning signal, it could not be expected to avoid accidents caused by mechanical failures or disregard of existing railroad rules.

What Is an Interurban?

It seems to me that the word interurban as applied to electric railroads is often misinterpreted. The old-time interurban was strictly a local railroad, and yet the common definition of interurban is "between cities." The interurban electric line did not exist to handle the intercity business, but rather to take care of the stops made between the cities, the milk and the packages and the passengers of the farms and small crossroad hamlets lying in between the points at which the steam railroads stopped. Hence the term interurban to distinguish the local electric lines from the railroads which served only cities.

New Station in Chicago?

Railroads operating into the Chicago terminals south of the loop, Grand Central, Illinois Central, LaSalle Street, and Dearborn stations, are working on a terminal solution which might consolidate these stations and remove some trackage, which according to civic associations, blocks southward expansion of the downtown area. Meanwhile the city council threatens to cancel permission by which the lead track for the Dearborn Station annex crosses a street. If this were done the capacity of Dearborn Station would be seriously curtailed.

Many plans have been proposed, even as early as before World War I, but some were patently impracticable and others obviously too expensive. Now it is suggested that the plans integrate use of railroad rights of way with local rapid transit plans, a scheme which has also been proposed in Boston, Cleveland and Milwaukee. No details have been decided as yet, but this time it looks as though the meetings of railroad executives are in real seriousness and some action will result which will be a real improvement from the standpoint of railroad operations and passenger convenience.

The South Side Terminal Committee is headed by Fred G. Gurley, president of the Santa Fe, and has appointed Charles P. Richardson full-time terminal engineer. Mr. Richardson is engineer of capital expenditures of the Rock Island and has been engineer of a number of important projects in the Chicago area.

Man Bites Dog

Railroads often suffer more damage in grade crossing collisions than do autoists. Even slight damage to a locomotive can run into four figures, and a derailment, tieing up the line, may cost tens of thousands of dollars. But the damage suit is inevitably against the railroad, not against the motorist. Now the motorist may find himself the defendant. As the result of a truck-train collision in Chehalis, Wash., the truck owner sued the railroad for $1155. But the railroad counterclaimed for damages to locomotive, standpipe and station platform. The railroad won the judgment for $1250 and the trucker's claim was denied.

What Cost Featherbedding?

An article entitled "Labor's Featherbeds—What They Cost You," by Merlyn S. Pitzele in the *American Magazine*, refers to so-called featherbedding or make work rules as a practice which is far from general among labor contracts, but which flourishes in certain old line, tightly knit craft unions, particularly building trades, printing, entertainment, teamsters, and the railroad brotherhoods.

The article described some of the specific means of featherbedding, and remarks that, "On the railroads the featherbed rules became entrenched when the railroads were losing ground to other means of transport and travel. The unions made their rules to keep workmen from losing their jobs and sinking into unemployment or deserting to other industries. But

A Hog Can Cross America Without Changing Trains—But YOU Can't!

The Chesapeake & Ohio and the Nickel Plate Road again propose to give humans a break!

It's hard to believe, but it's true.

If you want to ship a hog from coast to coast, he can make the entire trip without changing cars. You can't. It is impossible for you to pass through Chicago, St. Louis, or New Orleans without breaking your trip!

There is an invisible barrier down the middle of the United States which you cannot cross without inconvenience, lost time, and trouble.

560,000 Victims in 1945!

If you want to board a sleeper on one coast and ride through to the other, you must make double Pullman reservations, pack and transfer your baggage, often change stations, and wait around for connections.

It's the same sad story if you make a relatively short trip. You can't cross that mysterious line! To go from Fort Wayne to Milwaukee or from Cleveland to Des Moines, you must also stop and change trains.

Last year alone, more than 560,000 people were forced to make annoying, time-wasting stopovers at the phantom Chinese wall which splits America in half!

End the Secrecy!

Why should travel be less convenient for people than it is for pigs? Why should Americans be denied the benefits of through train service? No one has yet been able to explain it.

Canada has this service . . . with a choice of two routes. Canada isn't split down the middle. Why should we be? No reasonable answer has yet been given. Passengers still have to stop off at Chicago, St. Louis, and New Orleans—although they can ride right through other important rail centers.

It's time to pry the lid off this mystery. It's time for action to end this inconvenience to the public . . . NOW!

Many railroads could cooperate to provide this needed through service. To date, the Chesapeake & Ohio and the Nickel Plate ALONE have made a public offer to do so.

How about it!

Once more we would like to go on record with this specific proposal:

The Chesapeake & Ohio, whose western passenger terminus is Cincinnati, stands ready now to join with any combination of other railroads to set up connecting transcontinental and intermediate service through Chicago and St. Louis, on practical schedules and routes.

The Nickel Plate Road, which runs to Chicago and St. Louis, also stands ready now to join with any combination of roads to set up the same kind of connecting service through these two cities.

Through railroad service can't be blocked forever. The public wants it. It's bound to come. Again, we invite the support of the public, of railroad people and railroad investors—for this vitally needed improvement in rail transportation!

Chesapeake & Ohio Railway • Nickel Plate Road

Terminal Tower, Cleveland 1, Ohio

On their way from St. Paul to Duluth, these 19 veteran Chicago & North Western locomotives make their last trip by rail. These engines, which saw considerable service during both world wars, were cut up at Duluth and the scrap materials were shipped to steel mills in the holds of Great Lakes freighters. Included in the shipment were representatives of C&NW's classes F-6, M-1, G-3, I-1, and I-2.

their very tactics raised costs so much that the railroads lost even more ground."

Getting down to the brass tacks of the case, Mr. Pitzele says most of us probably feel much like this, "Look, let's begin all over. Everybody do a day's work without any goldbricking. Then the cost of production will come down, prices will come down, people will be able to buy more, and there will be more jobs for everybody. We'll have a prosperity of plenty."

The article continues, "But the union leader and the worker have to be shown. They may be reluctant to give up something that looks like a good thing. They must be educated to the fact that restriction on output does not make jobs, but loses them. Actually, great progress can be made against featherbedding only when we attack the underlying cause of it—the fear of unemployment. Adequate unemployment compensation can wipe out some of these fears. . . . But full employment in America is the best answer. If everyone is assured of a job there will be no reason to try to hold back in order to spread the job out."

Fan Trips

A last chance fan trip over all existing lines of the Reading Street railway will be run late in April or early in May by the Reading Chapter, NRHS. Write John Hand, 344 Douglass Street, Reading, Pa. A schedule of 11 1946 fan trips has been laid out by the New York Division, Electric Railroaders' Association, 51 W. 35th Street, New York 1, N. Y. Notices will be sent to anyone asking to be put on the ERA trip list. The Connecticut Valley Chapter of NRHS plans eight trips for 1946. The first is April 7 over New Haven branches with multiple-unit electric. To get circulars of all trips write Roger Borrup, 285 Plymouth Street, Stratford, Conn.

Amateur Camera Contest

A contest with $4500 in prizes for the best photos taken in Zion, Bryce and Grand Canyon (north rim) national parks, Kaibab National Forest and Cedar Breaks National Monument is being sponsored by Union Pacific. Photos must be taken this summer. For information write Mr. Hunter, Room 120, Union Pacific Headquarters Building, Omaha 2, Neb.

Odds and Ends

The Jersey Central has many improvement and expansion plans, but the extent to which such plans can be carried out will depend largely upon whether the road can get some relief from unfair New Jersey state taxes, which are nine times as much per mile as the nationwide average, according to R. E. Thompson, general manager of the road. . . . Because the town's Commercial Club wanted to call Stanton, Ia., the "little white town" the Burlington painted its station glistening white instead of the conventional red.

The New York Central and the Chicago & North Western have been putting some of their new Pullman-Standard coaches into service. . . . The Pennsylvania's huge intertrain communication program on the Middle Division is making slow progress because of delayed material deliveries, but all K-4s and M-1 engines assigned to the division are being equipped as they get class repairs at Altoona. ITC is standard on the new T-1's. This is the largest train communication project underway in the country. . . . End of the war is officially signaled by the return of barber service on the *Twentieth Century*.

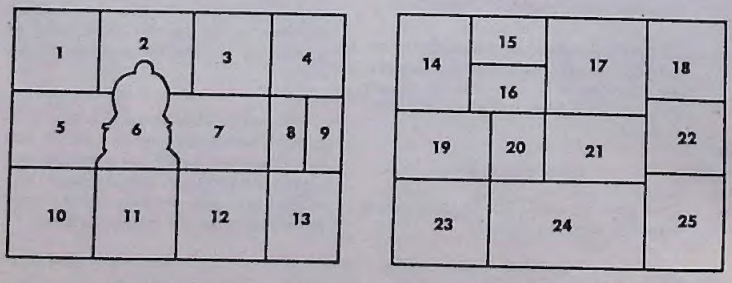


Diagram of photos and credits for picture montages on pages 10, 11, 12 and 13.

1, 18—Wm. Moedinger Jr.
2, 4, 10, 14, 21—Railroad Photographic Club
3, 7—A. P. Sozio
5, 6, 11, 19, 25—Pennsylvania Railroad
8—Pierre M. Ditto
9—Thomas Emden
12—Harold M. Lambert
13, 20—W. R. Osborne
15—R. O. Plinn
16, 22—Long Island Railroad (PRR)
17—Office of War Information
23—Raymond Moody
24—E. P. Alexander

The President Postpones Railroad Strike

The threatened railroad strike was postponed at the last minute, as expected, by presidential appointment of an emergency board. This means the wage dispute will probably be settled by some compromise increase much as the last two wartime wage disputes have been settled. An increase in freight rates of substantial proportions will no doubt be necessary, and a near future decrease in passenger fares is now much less certain than it was a while ago. No one expects the railroads to absorb wage increases out of profit, for even during the best year of the war, railroad profits were not sufficient to support the requested wage increase. As wartime volume slumps off an increase in rates is already becoming necessary to cover the past increases of 21.3 per cent in wages and 29.8 per cent in materials since 1941.

TRAINS has been against all *immediate* postwar wage increases in any industry on the grounds that they cheat the workingman himself in the long run. All but five per cent of our national price structure is ultimately reducible to wages and that means if wages go up, prices must go up and the value of savings and war bonds goes down. The pretty talk about industry absorbing wage increases is good only as long as wages in *only one* industry go up, but it becomes increasingly evident, as economists knew all along, that the price of new automobiles, for instance, will be affected not only by auto worker wages but also by the increase in steel wages and coal miner wages and railroad wages and building wages, etc.

The only wage increase which really means anything to the worker is the wage increase which results from more efficient production. This increase means something because it does not correspondingly raise prices.

Railroad men have long felt that some wage increase would be possible if salaries to officers were less and if each road had fewer vice-presidents. We wondered just what avenue of solution this offered, and took the 1942 I. C. C. wage and salary statistics as a basis. If we chopped off the heads of every railroad officer or employee getting $10,000 a year or more and eliminated these salaries altogether, the money saved is only some $21 million, enough to give the rest of the workers an increase of less than three-quarters of a cent on the dollar. Clearly this isn't a way out.

Anyway, other large segments of the working population have now obtained wage increases of from 15 to 20 per cent, thus causing further price increases beyond those caused by the expense of fighting a war which all of us still have to somehow pay for. So the railroad men surely deserve to be kept in their relative position with other labor groups. Railroad men work hard, and many of the road jobs are tough in other ways, such as being away from home and having odd, often uncertain hours. For this railroad men have earned more than men of similar skill in other work, and they have deserved it. The differential between railroad pay and other pay has apparently been about right. It should be maintained, even if it means that railroad prices like all others go up. At least railroad prices did not go up first, and in fact were maintained at or below prewar levels for years after everything else had started to increase. The constantly increasing efficiency of railroad transportation made this possible in spite of cost increases greater than at any previous time.

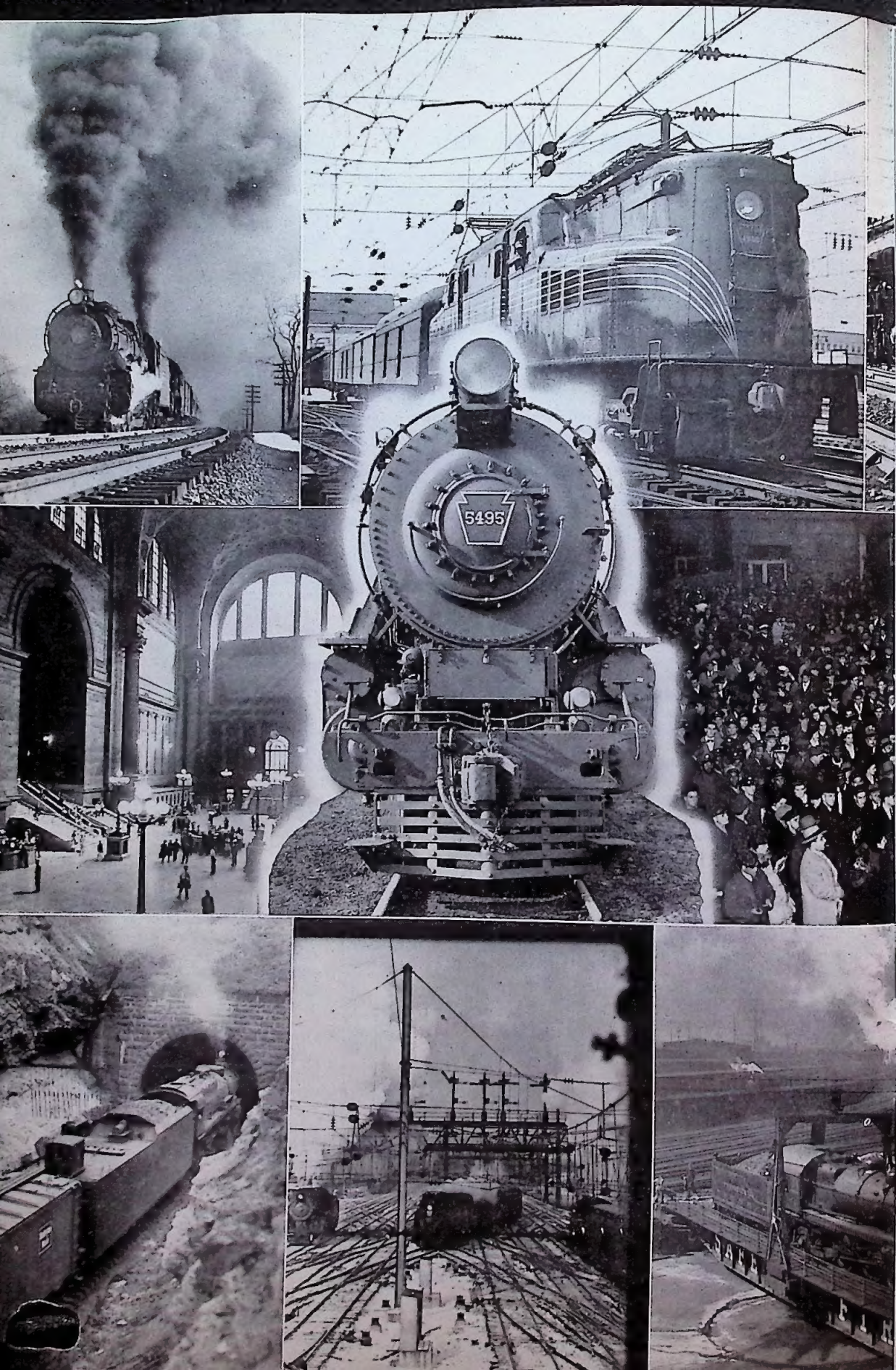
But the efficiency of railroad transportation will not continue to help the country if the rule changes which are also an issue in the current labor demands are approved. These rule requests are most unfortunate for the country at large and for railroad labor itself in the long run. They are designed to further force the railroads to pay for work which need not be done. For instance, the length of freight trains would be limited to 70 cars and of passenger trains to 14 cars. This would force operation of more sections of trains and the hiring of more men. It looks good, on the short view. More employment. More purchasing power.

But an unnecessary job does not create purchasing power. Purchasing power is created only by production. A job created merely by a labor contract is no more a real job than is government unemployment relief. It merely forces money to be paid for something useless which would otherwise go to create jobs in other ways, such as new passenger trains or perhaps mainline improvements or reduction of bonded indebtedness and fixed charges. The other ways of using this money would in the long run bring more traffic to the railroads and create more trains and more operating department jobs. And this would be done without raising prices in order to pay for unneeded labor.

The railroads have contributed more to America's standard of living than any other industry. They are the assembly line of our nationwide production system. They move our goods at the lowest rates in the world, and with the greatest efficiency. This mobility has enabled our country to produce in huge quantities and this production has meant that average American families have automobiles, radios, and other things that are luxuries in other parts of the world.

Some people seem to have the queer idea that average families can have even more of the same thing by simply squeezing the money out of "big business." This isn't so. The money can't be squeezed out without getting it back in prices. A general wage increase of less than 10 per cent, at same price level, would eliminate profit and industrial improvement altogether. But the average American family can get more material good things of life by producing more. Labor, if it ever wants to get more for its hours of toil, should encourage every possible technological improvement. It is only by grace of the increased efficiency of the railroads that tens of thousands of men still have railroad jobs today, for otherwise the railroad would now be extinct as the dodo, its function taken over by trucks and boats and busses. And if railroad men insist upon more featherbed rules to further stifle railroad efficiency they will find railroads becoming less and less useful and abandonments growing greater and greater. The railroad men may get jobs elsewhere, but the country will be the loser by missing the efficient transportation it might otherwise have had. This is the great threat of the current railroad labor negotiations.

A. C. Kalmbach.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THE PENNSYLVANIA RAILROAD

Chartered April 13, 1846

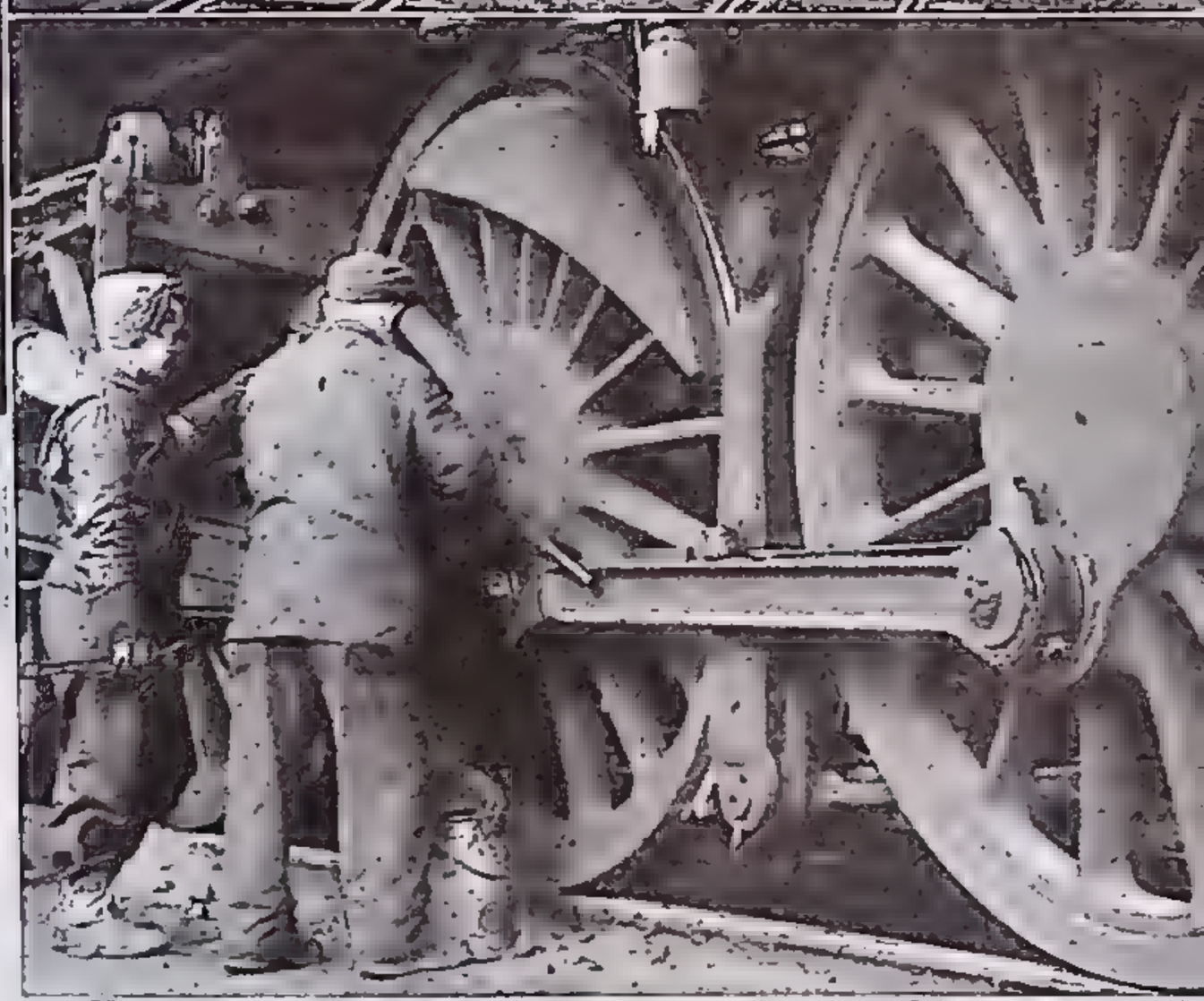
The Pennsylvania Railroad hauls more freight and carries more passengers than any other railroad in the world. . . . It operates more miles of track than any other American railroad and moves the heaviest steam hauled mainline traffic, over the Alleghenies between Altoona and Pittsburgh. . . . The greatest show on earth is the continuous parade of trains on the electrified New York-Philadelphia line. . . . The Pennsylvania has paid a cash return to stockholders continuously since 1847, the longest record of any American corporation. . . . About half the country's population and two thirds of the country's wealth and resources are in territory reached by Pennsylvania. . . . A capital investment of over three billion dollars is represented in the railroad, which is owned by 218,000 stockholders. . . . Gross revenues are the largest of any railroad in the United States. . . . Although coal is only 21 per cent of freight revenue, Pennsylvania is the country's greatest coal carrier. . . . Truly a study in superlatives is the Pennsylvania Railroad.

KEYSTONE VIGNETTES

A great railroad in action

Horseshoe Curve seen in the moonlight from a sleeping car window of the Broadway, with the Altoona water reservoir shining below and a westbound freight across the curve, three engines creating a symphony of motion. . . . Over the Fort Wayne Division at better than 100 m.p.h. making up time on that last beautifully straight speedway into Chicago. . . . Rails singing underneath a New York-Philadelphia "clocker" as trains in both directions zip past and behind. . . . The crowded tracks in the Packsaddle east of Pittsburgh after midnight with the fleets passing east and west and the position-light signals blinking vertical and then promptly back to horizontal again. . . . Pennsylvania Station, New York, the gaunt steelwork of its concourse almost but not quite dwarfing the constant crowds seeking trains. . . . The stone arches of Rockville bridge across the Susquehanna seen through morning mists from the train windows. . . . The steel mills of Aliquippa throwing their bright glow across the Ohio as the Liberty glides along west of Pittsburgh at two o'clock in the morning. . . . The marvelous intricacy of the flying and burrowing junctions at Zoo interlocking, Philadelphia, and the weird interweaving of Broad Street, Washington line, and high level freight line tracks near 30th Street station. . . . The airy web of innocent looking but powerfully potent wires over the electrified lines. . . . The high rounded boilers of K-4's shining in the half light as they back under the post office and into Chicago Union Station. . . . And the glamour of the brightly lighted rear-end signs lined up in St. Louis. . . . All that and more beneath the tuscan red keystone of Pennsylvania Railroad.

SL-ST



Edwin P. Alexander collection.

Among the earlier companies which in time became a part of the Pennsylvania Railroad was Camden & Amboy, one of the oldest American railroads. This 1854 photo shows a C&A train pulled by its historic locomotive John Bull. Bridge below is on original Pennsylvania main line. West Chester & Philadelphia, opposite page, also became part of the Pennsylvania.

Edwin P. Alexander collection.

Beginnings of a Railroad

The Pennsylvania Railroad, founded in 1846, built main line across state, absorbed other companies to expand

BY EDWIN P. ALEXANDER

This month the world's largest railroad is 100 years old. The Pennsylvania Railroad was chartered by the state of Pennsylvania April 13, 1846, and came into being with a franchise to build the first all-weather route through the broad valleys and across the backbone of the Alleghenies from Harrisburg to Pittsburgh, then a wilderness outpost. Today the steel of this same route shines bright under the constant polishing of flanged wheels, and locomotive exhaust continually echoes from one green slope to another with the movement of the heaviest steam railroad traffic in the world.

The newborn Pennsylvania Railroad was not the first means of common carrier transportation across the central portion of the state, for 18 years earlier the legislature had chartered a State Works to provide a transportation route all the way from Philadelphia to Pittsburgh by means of railroad, inclined planes, and canals. A primitive form of railroad joined Philadelphia with Columbia on the Susquehanna, a canal followed the Susquehanna and the Juniata to Hollidaysburg, the Allegheny Portage Railroad crossed the backbone of the mountains to Johnstown, and then a canal finished the job down the Conemaugh and Allegheny valleys.

This older route was to be paralleled by the new railroad from Harrisburg up the Susquehanna and Juniata valleys and across the mountains to Pittsburgh. East of Harrisburg the new railroad could connect with a privately owned road nearly to Lancaster and then with the state owned Philadelphia & Columbia to Philadelphia. Thus the Pennsylvania Railroad became the link which completed an all-rail route across the state.

The original charter allowed capital of $10 million. Thirty per cent of this was to be paid into the treasury and a minimum of 30 miles of line was to be under contract for construction before July 30, 1847, or the Baltimore &

All photos from Edwin P. Alexander collection.

Ohio would be granted a charter to build a connection from its line at Cumberland into Pittsburgh. The conditions were met. On July 16, 1847, a contract was let for the first 20 miles west of Harrisburg and within a week another contract was let for 15 miles at the Pittsburgh end. The stipulated cash was paid in. Consequently the B&O rights were declared void.

Then appeared the first of the great men of the Pennsylvania, most of whom, over all of this past century, have been engineers rather than financiers or manipulators. John Edgar Thomson was the first chief engineer, appointed April 9, 1847, and was president from 1852 to 1874. It was under his direction that the magnificent alignment was carried up the valley of the Juniata, up the steep eastern slope of the Alleghenies by means of the scenic Horseshoe Curve, under the crest through the Gallitzin Tunnel, and then down into the valley of the Conemaugh and on to Pittsburgh.

The first division of main line, 61 miles from Harrisburg to Lewistown, was opened for traffic in connection with the canal and turnpike on September 1, 1849. One locomotive was on the job this opening day, a 4-2-2 Crampton type engine named Mifflin and built by Baldwin. Other engines followed in quick succession, some of them to the same wheel arrangement and others of them four, six and eight coupled. By the end of 1849 there were 11 in service.

The Cramptons carried examples of all the mechanical complexities of their time. They had hook motion valve gear for the main valves and also independent valves which, when in operation, cut off the steam at half stroke. The frames were outside the wheels and the cranks were inside directly on the inner faces of the driving wheels. The equalizing beams were mounted so that when starting the fulcrum could be changed to throw more weight on the drivers. The weight distribution could be returned to normal when underway.

For all of that these engines were built for speed. The cylinders were oddly placed to counteract vibration and the 72-inch drivers could really turn around. One of the Pennsylvania's Cramptons has a record of four miles in three minutes and another of the three first built made quite a run at a mile a minute.

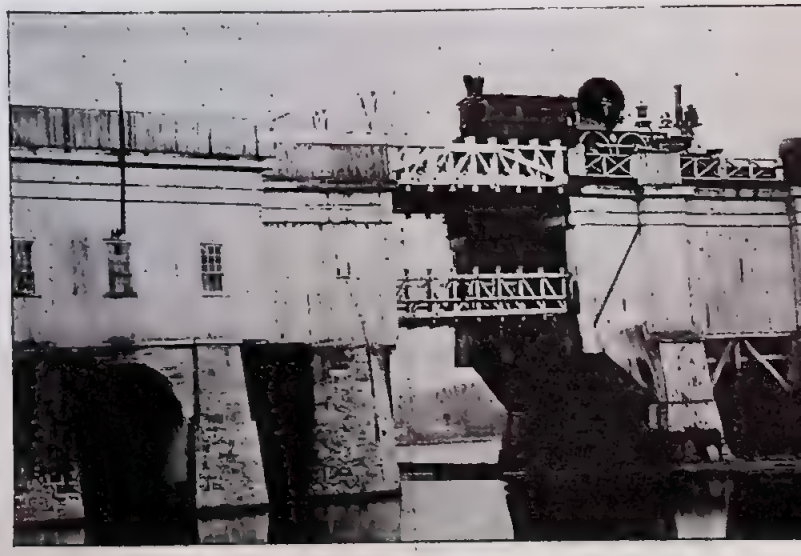
Right from the start the new road carried some pay traffic but the object, of course, was an early through connection across the mountains so as to furnish the all-weather route that the state desired when it issued the charter. So the Cramptons and the six-coupled and the eight-coupled engines did most of their work on trains of men and supplies and ma-

Broad Street station, Philadelphia, as originally built in 1881, is shown at left. It was enlarged in 1894 to a full block in width. Above is the station of Civil War times at Harrisburg. Bridge below is over the canal at New Brunswick where a great masonry viaduct now crosses the Raritan.

terials heading always toward the mountains from both ends of line. Gradually the railheads moved closer and closer together. By December 24, 1849, the line was complete from Harrisburg 72 miles to McVeytown. By June 10, 1850, it had reached Huntingdon, 97 miles. On September 17, 1850, the line was opened to the Mountain House, a mile east of Hollidaysburg, where connection was made with the state-owned New Portage Railroad on October 1. This took Pennsylvania Railroad trains for the first time over the summit and enabled construction to begin down the west slope toward the track which had been completed eastward out of Pittsburgh. By August, 1851, 21 miles were finished west of Johnstown, leaving only a 28-mile gap. The first through train from Philadelphia to Pittsburgh ran on December 10, 1852, using the Philadelphia & Columbia, the Pennsylvania and the New Portage Railroads.

Regular through service did not begin until the following March 3 when the Pennsylvania Railroad obtained the right to operate directly into Philadelphia over the tracks of the Philadelphia & Columbia. The railroad later built its own station in Philadelphia at 11th and Market Streets, opened May 20, 1854.

Meantime trains were still using the state's tracks over the Allegheny Summit, but construction was going ahead on the Pennsylvania's own mountain crossing. Where the new line branched off from the New Portage connection railroad surveyors laid out a shop city with its streets as square and parallel to the tracks as the rails in a yard. Thus was Altoona born, the city which was destined to make and repair the railroad's equipment. Above Al-

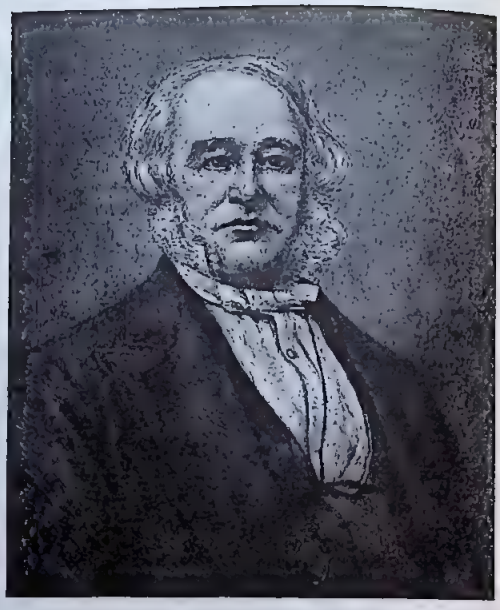


toona Thomson's surveyors sighted their transits and drove their stakes, folding a line neatly back into the recesses of Burgoon Run with a long horeshoe of a curve which enabled the railroad to breast the steep east slope of the mountains with only 92 feet per mile grade. The railroad's own tunnel, single track, was bored through the summit only a few dozens of feet north of the double-track New Portage tunnel, and by February 15, 1854, the line was complete. A new schedule was started of three through trains a day in each direction, the trip from Philadelphia to Pittsburgh taking from 13 to 17 hours.

Probably the first private railroad acquired by the Pennsylvania was the Harrisburg, Portsmouth, Mt. Joy & Lancaster, chartered in 1832, and built before 1838. Its first president was James Buchanan. Before the Pennsylvania completed its own line it contracted on November 1, 1848, to operate the Lancaster road for 20 years, later changed to a 999 year lease and still later to outright purchase. The small road formed an important link from Harrisburg down to the Philadelphia & Columbia, with which it connected at Dillerville, just west of Lancaster. Pennsylvania mainline trains still swing around a broad curve at Dillerville, junction of a branch line straight west to Columbia and York.

Now that a private railroad was running across the state, the citizens found their State Works losing even more money. This system of canals, railroads, and inclined planes had been begun in 1828 when, because of diversion of western trade to the Erie Canal, an alternative route via Pennsylvania seemed necessary to maintain Philadelphia's position among eastern seaboard cities. The line as laid out and authorized by the legislature on March 24, 1828, consisted of four divisions. First was a railroad from Philadelphia to Columbia, 82 miles, as planned five years earlier by John Stevens. Then came a canal from Columbia up the east bank of the Susquehanna to Middletown where it joined the river, continued to Duncan's Island, and then crossed into the valley of the Juniata which it followed to Hollidaysburg. In this distance of 172 miles an elevation of 585.8 feet was overcome with 111 levels.

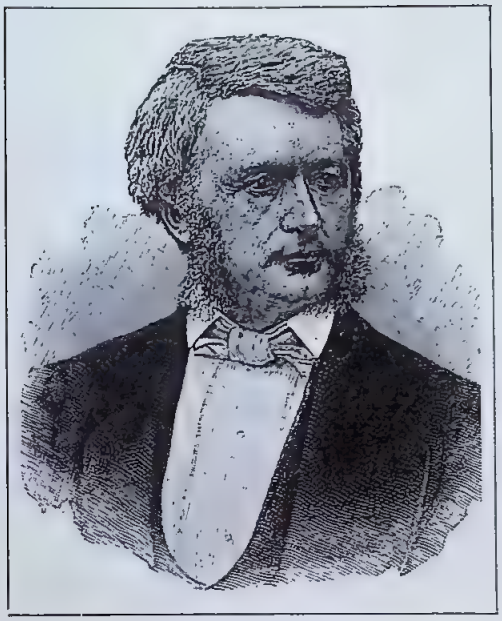
The key section was the Allegheny Portage Railroad which used 10 inclined planes to cross the summit of the range. The planes were powered by stationary engines which usually pulled a train up with a huge rope at the same time that another was being let down. The line was at first single track, but after only two years it was double tracked. The first railroad tunnel in America, 900 feet long, was bored just above Johnstown. Last section of the State Works was canal for 104 miles from Johnstown to Pittsburgh, and in this distance 66 locks were used to overcome an elevation of 471 feet. To assure water supply a dam was built across a branch of the Conemaugh River above Johnstown, and the failure of this dam many years later was the cause of the Johnstown flood.



Two of the greatest early presidents of the Pennsylvania Railroad were J. Edgar Thomson and Thomas A. Scott (right). Thomson was the chief engineer responsible for the line over the Alleghenies and was president from 1852 to 1874. Scott (1874-1880) followed him in expanding the boundaries of the system to approximately their present extent.

Even before the organization of the Pennsylvania Railroad the operation of this State Works was carried on at a loss due to mismanagement and politics. Travel was very slow because of the canals, and everything came to a stop with freezing weather. Agitation for better transportation finally took the form of a mass meeting in Philadelphia March 6, 1838, at which surveys were ordered for various routes of privately owned railroad to Pittsburgh. Three possible routes were reported on in 1840 and the third, most practical, was that ultimately taken by the Pennsylvania Railroad.

As the Pennsylvania Railroad came into



being the state started improving the cross-mountain section of its system. The New Portage Railroad was built eliminating the planes, but it was barely finished when the Pennsylvania Railroad started operating its own line over the mountains as a through railroad route across the state. The State Works became even more unprofitable and the people started a movement to sell the entire state system. A bill passed in 1854 offered the entire property for $20 million, but there were no takers so in 1855 the price was reduced to $10 million. Still there were no takers, and in 1857 the offering price went down to $7.5 million, with the further provision that should the Pennsylvania Railroad buy the State Works it could, for an additional $1.5 million, be relieved of any further taxes on freight or tonnage.

The canal and railroad system was then officially put up for sale and purchased by the Pennsylvania Railroad on August 1, 1857. With this acquisition the through cross-state service improved. The Philadelphia & Columbia Railroad was, of course, the most important part of the purchase, for it was what put the Pennsylvania directly into Philadelphia on its own rails. The canals were soon abandoned. Portions of the New Portage Railroad were eventually used as realignments of the Pennsylvania Railroad main line on the Pittsburgh Division, and the New Portage grade up the east slope of the Alleghenies, including Muleshoe Curve, was used years later for a double-track relief freight line which is more roundabout but of about the same gradient as the Horseshoe Curve four-track main line.

Once the railroad became a really efficient through route between Pennsylvania's largest cities it had reached its major terminals as far as the citizens of the state were concerned. Pennsylvanians still tend to regard Pittsburgh and Philadelphia as the ends of the line, and the extensions beyond as mere feeders. But under John Edgar Thomson and his successor, Thomas Alexander Scott, the Pennsylvania Railroad in the 1860's and 1870's refused to acknowledge these termini.

Interest was gradually acquired in the prime westward connection at Pittsburgh, the Pittsburgh, Fort Wayne & Chicago, and finally in 1869 the road was purchased. This became the main line into Chicago, which is still known as the Fort Wayne. The Panhandle was acquired as an extension southwestward out of Pittsburgh across the West Virginia panhandle into Ohio, through Columbus, to Cincinnati, Indianapolis and to Chicago via Logansport.

Pennsylvania trains once came into Chicago Union Station from both sides, Panhandle from the north, Fort Wayne from the south, and Pennsylvania Station in Pittsburgh even today has two sides for through trains, the Fort Wayne side and the Panhandle side. The Vandalia (St. Louis, Vandalia & Terre Haute) took the road into St. Louis, where the towermen at Relay still call the route by saying, "Van No. 33 on 2."

On the eastern end the connections south of Philadelphia, acquired in 1881 as the Philadelphia, Wilmington & Baltimore, started in the early 1830's when a number of connecting companies were chartered to build along this section of the Atlantic seaboard. Except for a ferry across the Susquehanna River the lines were completed in 1837 and consolidated in 1838. The river was bridged in 1866 and through train service was started. To extend this line to Washington the Baltimore & Potomac started construction in 1868 to Pope's Creek, Md., with a "branch" from Bowie to Washington. This was the only way to get into the capital city because of charter and other restrictions.

Another important link in the Baltimore connections was the Northern Central Railway whose cornerstone as the Baltimore & Susque-

hanna was laid August, 1829. By 1858 it had a line from Baltimore to Sunbury, Pa., 138 miles. For a time the B&O owned a majority of the stock, but in 1861 the Pennsylvania acquired it.

But the really great extension of the Pennsylvania was that across the state of New Jersey to the very edge of New York harbor at Jersey City.

It was in 1871, July 1 to be exact, that the Pennsylvania Railroad took over the United New Jersey Railroad & Canal Company. This company was a direct lineal descendant of the Camden & Amboy, to which several notable firsts in American railroading can be traced. The forerunner to its charter was the first ever granted for a railroad in America, to John Stevens in 1815. Several attempts were made in the 1820's to start either a railroad or a canal across New Jersey, and finally in 1830 a compromise was effected between the proponents of rail and water and charters were granted simultaneously to the Delaware & Raritan Canal and to the Camden & Amboy Railroad. The following year both were merged by act of the legislature and construction was begun.

The canal, from the Raritan at New Brunswick to the Delaware at Trenton, was 43 miles long and the 34 miles to South Amboy were completed in 1833. The next year connection

The old reversed photo on Horseshoe Curve shows a train typical of the 1880's on the Pennsylvania Railroad. The neat cap-stacked engines were characteristic of the road. Old engines below include the John Bull, now in the National

was completed in the other direction to Camden, across from Philadelphia, and through service was started over the 61 miles from Camden to South Amboy. The route between New York and Philadelphia was by steamboat to South Amboy, then by rail to Bordentown, then by steamer again down the Delaware to Philadelphia. In 1832 the New Jersey Railroad built a line from the Hudson River to Elizabeth and by the next year on to New Brunswick. By 1839 the Camden & Amboy had built a connection from Bordentown through Trenton to New Brunswick and the first all-rail route between New York and Philadelphia was complete except for connections across the rivers at each end. In 1840 an old bridge (1804) at Trenton was strengthened to accommodate a single track and through rail travel into Philadelphia was possible. In 1867 the various New Jersey companies were merged into the United New Jersey Railroad & Canal Company, and in that same year the Pennsylvania opened its negotiations looking toward making the New Jersey companies its New York extension.

Our standard American track of today owes its origin to the capable John Stevens of the Camden & Amboy. Shortly after the surveys for the road were made in October, 1830, Robert L. Stevens, president and chief engineer, sailed for England to order a locomotive and rails. During the voyage he spent the hours whittling wood into patterns suitable for rail cross sections. The one he finally decided upon was the first T rail. He also invented the hooked spike for fastening. After many delays in rolling, the rail was finally shipped from England.

Meanwhile the stone blocks upon which the rail was to rest were to be made at Sing Sing Prison. The authorities there were slow in their deliveries and as a temporary measure Stevens ordered hewn wooden crossties used temporarily. They were laid first in a deep cut at Bordentown and were so satisfactory that they were not replaced by the stone blocks, but eventually became the standard for railroad track construction.

While in England Stevens spent some of his time watching the trials of the Stephenson locomotive Planet, and it seemed so satisfactory he ordered a similar engine for the C&A. It was shipped completely knocked down, and although no drawings came with it, a young mechanic, Isaac Dripps, succeeded in putting it together at Bordentown and it was christened John Bull. No tender came with the engine, and a four-wheel car was improvised upon which a whisky cask served to carry the water supply. It was connected with the boiler pump by a shoe leather hose made by a local shoemaker. The first pilot truck was designed for this same locomotive in 1832 to prevent the frequent derailments on curves.

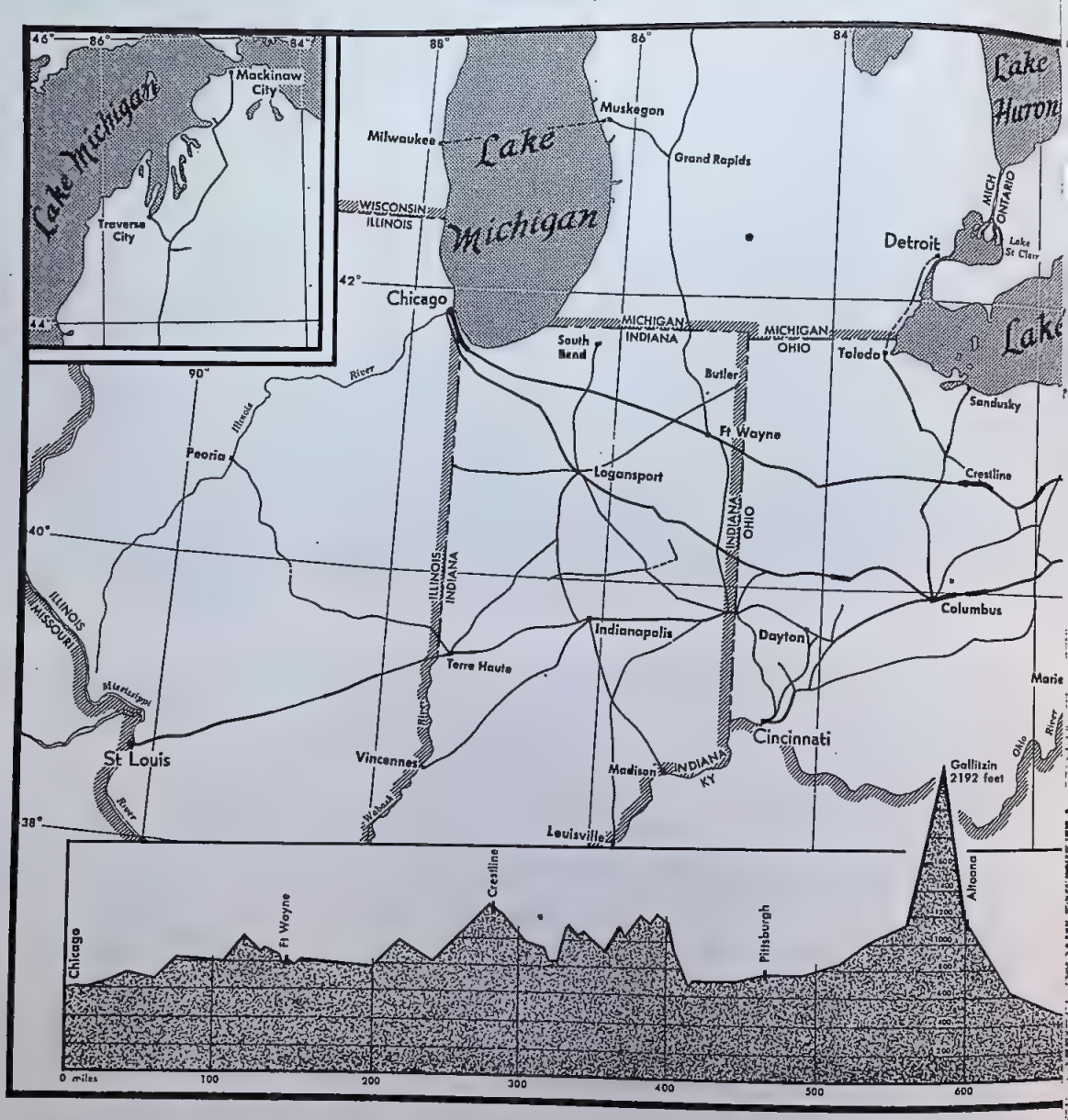
Thus the New Jersey companies brought into the Pennsylvania not only mileage, critical mileage at that, but pedigree, an ancestry of early achievement in American railroading.

By 1881 these and many hundreds of smaller acquisitions had stretched the Pennsylvania Railroad nearly to its present extent. The foundations had been laid for the railroad of today, the foundations in routes through the heavy traffic areas of the East, the foundations in sound engineering, and the foundations in good management. The rest was growth and expansion and improvement.

Museum, photographed after addition of pilot and covered tender; Assanpink built for the Belvidere Delaware by Trenton Locomotive Works, and typical 4-4-0's of the Northern Central and the Philadelphia, Wilmington & Baltimore.

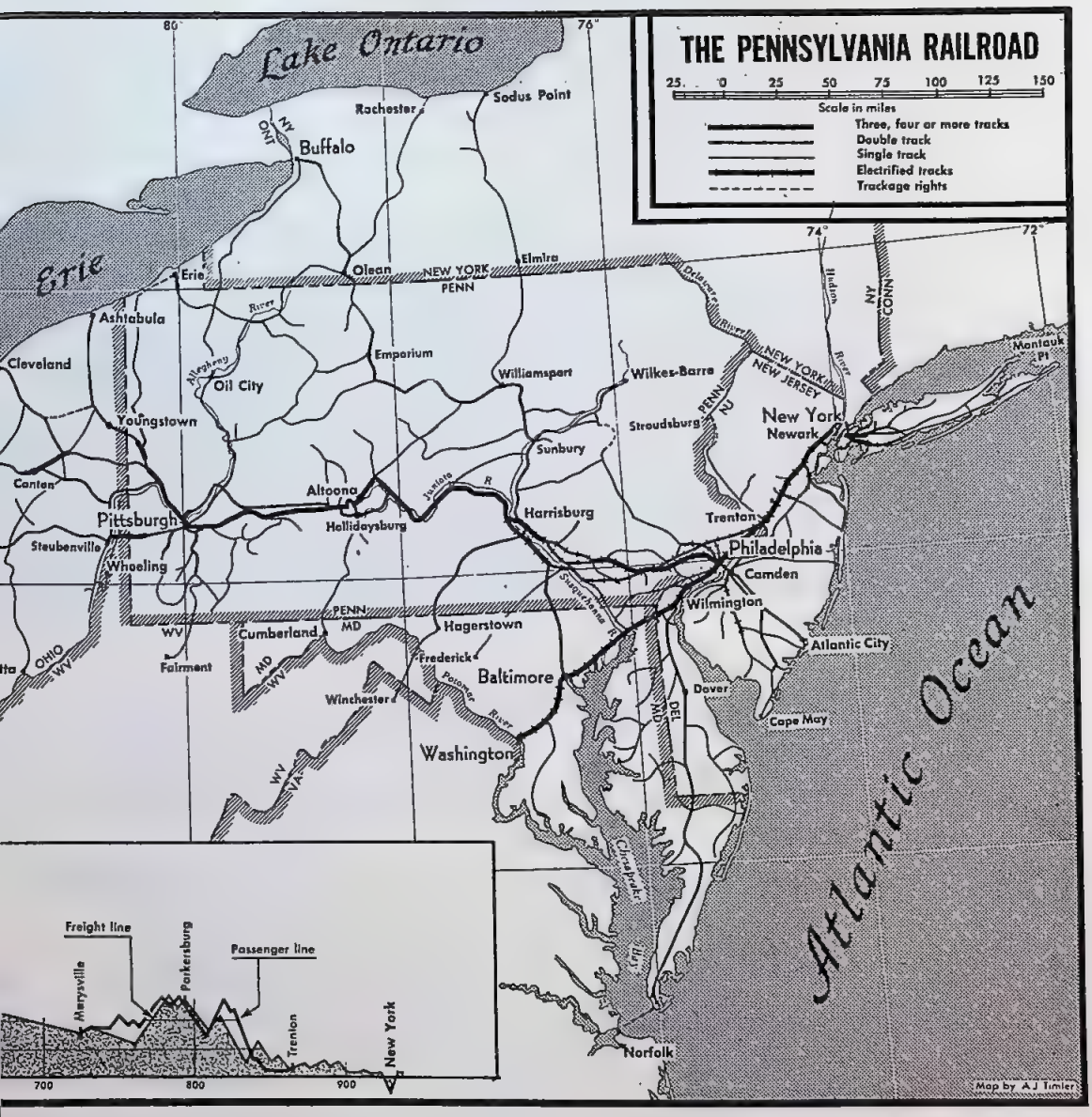
The first Pennsylvania Railroad bridge across the Susquehanna at Rockville, above Harrisburg, was this structure with wooden spans built on the Heur plan and supported on masonry piers. It was partly destroyed by fire in 1868 and rebuilt. Iron trusses replaced it in 1877, and stone masonry in 1902. The old Pittsburgh Union Station (left) was opened in 1865 and destroyed by fire during the riots of 1877. It was replaced by a brick two-story structure, and later by the present station during the Cassatt era, 1901. Fort Wayne tracks are in foreground, crossing Liberty Avenue, and Panhandle tracks are in background. The main line (below at Conemaugh, Pa.) in Civil War days was a line of stub switches and light rail, but today's railroad was already in genesis. Industry, stimulated by transportation and natural resources, was also growing.

All photos from Edwin P. Alexander collection.



When the Pennsylvania Railroad's founders projected their route over the mountains to Pittsburgh they had only a slight concept of the importance their line would attain. As the middle and most direct of the three great routes from the Atlantic to the Ohio Valley, the Pennsylvania way became, like the neck of an hourglass, the focal point for the greatest overland traffic in the world. Today the original link between Harrisburg and Pittsburgh, 245 miles of four tracks, though still the heart of the system, is only a small part by miles. The railroad now operates in 13 states. To the east New York City and Washington are connected by an electrified four- and six-track main line densely traveled. Northward laterals extend to Sodus Point, Rochester, and Buffalo. To the south other laterals bring a majority of the northbound coal and seaboard traffic onto system rails. Westward a vast net reaches every great city in the Ohio Valley.

The lacework of branch lines in the original Pennsylvania region tells another important story, that of coal. It was in this area that the



first great deposits of soft coal were mined and shipped out in Pennsylvania Railroad cars. This was for long the coalbin of the nation. The railroad was the shovel. But something even more important happened. Iron ores were sent to Pittsburgh from all parts of the country and particularly from Minnesota. Here they were heated with Pennsylvania coal and purified with Ohio lime into steel, the material that made the United States the most industrially wealthy nation.

But today coal and ore and steel are only a part of the railroad's important traffic. From Chicago and St. Louis the railroad picks up over $7 million in yearly revenue for shipping grain alone. Almost as important are both livestock and manufactured products. On the entire system iron and steel produce 9.2 per cent and manufactures 13.1 per cent of freight revenue.

Biggest single revenue maker on the system is the northward flow of coal to Great Lakes ports. Recent figures are obscured by war conditions but 10 years ago this was upwards of $52 million in a single year, nearly one sixth of the company's entire freight business.

The Era of Improvement

An audacious series of reconstructions expanded Pennsylvania Railroad's capacity in a critical decade

BY A. C. KALMBACH

In Pennsylvania Station, New York City, stands a statue, generally unnoticed by the hurrying crowd. The legend on the pediment reads:

ALEXANDER JOHNSTON CASSATT
PRESIDENT PENNSYLVANIA RAILROAD COMPANY
1899-1906
WHOSE FORESIGHT, COURAGE AND ABILITY ACHIEVED
THE EXTENSION OF THE PENNSYLVANIA RAILROAD SYSTEM
INTO NEW YORK CITY

Alexander Johnston Cassatt did not live to see the opening of the great station and terminal system he had created and some Pennsylvania men feel to this day that he gave his life in pushing the great project through toward completion. It represented the largest single expenditure incurred by any private corporation up to that time and was undeniably the boldest stroke of railroad strategy ever conceived. Yet it is only one of the monuments left to Cassatt, and if he gave the best of his life to the station, he also gave of his life to a whole era of audacious improvements which kept the Pennsylvania Railroad not only abreast but ahead of the floods of traffic originating in its rich territory.

For the story of the Cassatt era is a story of engineering accomplishment upon the railroad which was then handling one fifth of the country's freight tonnage and one sixth of its passengers. It is a story written with steam shovels and riveting machines, surveyors' transits and tunneling shields. It is a story of freight cutoffs around all principal points of congestion on the main line, of four tracking and of track elevation, of new stations and new yards, and of intricate flying and burrowing junctions to handle increasing numbers of trains without interference. It was the first decade of the 20th century and the Pennsylvania Rail-

Edwin P. Alexander collection.

Shortly after the turn of the century a bevy of light Atlantics and Americans stand ready at West Philadelphia engine terminal for evening suburban rush hour service.

road was being rebuilt bodily into a 20th century transportation machine. In this one decade the investment in the road and its total assets both tripled.

First and most necessary from the standpoint both of handling the traffic and of securing it was the extension into the heart of Manhattan Island. The idea was born with the lease of the United Railroads of New Jersey in 1871. The Pennsylvania could not be content to stop across the mile-wide river from New York City while its principal competition to the West, the New York Central, stood solidly entrenched in Grand Central a few blocks off Times Square.

The panic of 1873 put a stop to planning, for the task was admittedly an extremely expensive one, and needed a favorable money market. The crossing of the Hudson River, locally known as the North River, at its mouth was not to be compared with any other terminal proposal undertaken anywhere before. But by 1884 plans were again in full swing, this time for a North River bridge with span twice that of Brooklyn bridge. It was to be the joint project of several of the roads terminating on the New Jersey shore, but again a panic interfered. The same thing happened in 1892.

As the idea was again revived before the turn of the century, it became apparent that the other roads using ferries did not approve of the bridge plan and that the Pennsylvania would have to go it alone. A charter could not be had for a bridge unless it was for the use of several railroad companies, so the tunnel scheme came to the fore.

Now in 1900 the Pennsylvania Railroad acquired the Long Island Railroad and the general outlines of the terminal plan were rounded out. It was to be no ordinary stub end terminal, such as might be expected in a large city. It was to be a through station, erected over a tunnel railroad which would burrow from New Jersey, under the Hudson to the station site, then straight across Manhattan Island and under the East River into Long Island where coach yards and other terminal facilities could be placed. [See plan, pages 36-37.] At the same time it would provide New York quarters for the Long Island Railroad, improving commutation facilities and spreading the terminal cost over more users. And, most unexpected of all, the broad plan included also a connecting railroad across the western tip of Long Island and across Hell Gate on a huge bridge to tie up with New England via the New Haven. Thus New York was to become not only a terminal, but a way station on a through line of railroad all the way up the Atlantic coast.

The franchise was secured October 9, 1902, and work began on the tunnels the following June 10. Under Bergen Hill and the Hudson are two single-track tubular tunnels extending from the edge of the Jersey Meadows directly into the west end of the station track layout. Under the East River and the eastern portion of Manhattan Island are four single-track tubular tunnels. These are laid in two pairs, one of which is used largely by Long Island suburban trains and the other by trains to and from the Pennsylvania's Sunnyside coach yards. Through trains to the New Haven also use this latter pair. The entire length of line between the Bergen Hill and the Long Island portals is 5.3 miles, all of which is below the surface. The capacity of all the tunnels into and out of the station is 144 trains per hour. The initial service was about 600 Long Island trains daily and 400 Pennsylvania trains.

Motive power was not the least problem. Electrification was necessary and electric power for such heavy traffic was a new and practically

untried innovation. Third rail, with 600-volt direct current, was chosen and applied not only to the tunnels and terminal, but to the western end of the Long Island Railroad as well. The electrified line extended across the Meadows almost to Newark. At Harrison, near the junction with the original main line, an engine change point called Manhattan Transfer was set up and all trains changed between steam and electric power at this new station. Here also the Hudson & Manhattan tubes, now controlled by the Pennsylvania and completed about the same time as the terminal project, crossed the line and passengers could change across the platforms from through trains to tube trains for Hudson Terminal in downtown New York. The Pennsylvania now offers this dual New York terminal service at the Newark Station, since changing engines at Manhattan Transfer was made unnecessary in 1933 by through electrification with an overhead trolley system at 11,000 volts.

In spite of the difficulty of cutting tunnels partly through hard rock and partly through gooey river bottom mud, the work progressed continually until the North River tunnels were joined on October 9, 1906, just four years after the franchise was obtained. The East River tunnels were joined March 18, 1908. The station building, occupying nearly a half million square feet, had been begun May 1, 1904, while the tunnels were still in the early stages. By the summer of 1910 the work was well enough along to plan the opening operations.

Never in history had a railroad begun initial operations into such a vast terminal. All the previous large stations of the world were mere rebuildings of old facilities. But Pennsylvania Station was not only entirely new; it involved a new type of motive power and the new feature of engine changes on all incoming and departing trains. The public took it for granted that the trains would run properly when the regular through service into the new station was begun on Sunday, November 27, 1910. The railroad took nothing for granted. For two weeks in advance the entire terminal schedule was worked with empty trains. The trains were made up in Sunnyside Yards, moved to the station, stopped for the correct loading period, and then were run out to Manhattan Transfer where the electric locomotives were taken off and steam locomotives substituted. The same mock operation was performed

Edwin P. Alexander collection.

The flatness of the right of way as well as the old-type signals easily identify these photos as half a century old. The upper shows end of sidings on a newly four-tracked stretch of main line near Lancaster, Pa. Lower shows junction of main line to Harrisburg and line to Columbia at Dillerville. Curve in main line has just recently been eased. Old Broad Street station (upper right) at Philadelphia was the nerve center of the system.

for the scheduled incoming trains. Every movement was timed, not to the minute but to the second, for it was extremely important to learn exactly where the proposed schedules might fall short. One may ask where a railroad which was at the same time carrying on its usual business to the old Jersey City terminal might find all the equipment for such an experiment. The electric motive power was, of course, new, and not too many cars were needed to cover even a large number of runs over the short terminal mileage and during the yarding.

This one terminal project with its staggering cost of more than $100 million would have forced many a railroad into receivership. But not the Pennsylvania which has never been a "family" company. The stock has been widely held, and the company has always been run with a regard for the interest of the stockholders. Good management and continuous profit and dividend records had by 1900 earned a solid confidence. President Cassatt continuously preached the need of large improvements in his annual reports and took pains to show how improvements, when completed, started immediately to pay a return on investment. The result was that the Pennsylvania was able to easily finance not only the terminal program, but the many other projects which had the lines east of Pittsburgh in a constant state of rebuilding all during the first decade of the century.

The four-track system was extended until it included the entire line from New York to Pittsburgh with some portions of six track in New Jersey. Tracks through cities were elevated, and principal steel bridges were replaced with everlasting masonry. New stations were built not just at two or three isolated places but at dozens of cities all along the lines. Westward out of the new New York station the passenger rode over new track elevations at Newark, Elizabeth, Rahway and New Brunswick which made of the line across New Jersey a traffic free steel boulevard. At Trenton he went through the city on a new and straighter alignment, and over the Delaware River on a new four-track masonry arch bridge. Just beyond the west end of this bridge he viewed the eastern end of the new freight line which cut cross country to avoid Philadelphia and join the main line again some 25 miles to the west, beyond Paoli.

In Philadelphia proper the main lines west and south together with the Belmont Branch

Edwin P. Alexander collection.

joined at Zoo Interlocking just west of the Schuylkill River, and this busy junction was rebuilt into the first modern cloverleaf pattern. By a weird and confusing pattern of tunnels and overpasses the tracks were so arranged that trains could go over any of the routes without crossing other main lines at grade. At West Philadelphia a similar traffic separation scheme was worked out for trains into and out of Broad Street station, which had only a few years earlier, in 1894, been enlarged. A high line was built to take through freight trains completely across the congested West Philadelphia terminal area without interference. On the line toward Washington tracks were elevated at Chester and Wilmington, plans were started for a new station (the present one) and track elevation work at Baltimore and for the well-known Union Station in Washington.

Toward the west out of Philadelphia the engineers laid out a combination flying and burrowing junction of great proportions near the 52nd Street station, where the Schuylkill Branch leaves the main line. A long masonry and steel viaduct raised the westbound passenger track up and over the neck of the 52nd Street freight yard, putting it to the north of the yard where Schuylkill trains branch off without traffic interference. A single-track tunnel under the yard brings eastbound Schuylkill trains into the main line. West to Harrisburg 100 of the 104 miles were relocated.

At Harrisburg the new station was a comparatively minor item in the Pennsylvania im-

On the Main Line in 1905

Edwin P. Alexander collection

An afternoon local out from Philadelphia passes a light freight train on the main line west of the city. This was taken in 1905 and the open platform wooden coaches of the local are pulled by a 4-4-0 of the classic D-16 design.

provements. Even the almost mile-long masonry bridge across the Susquehanna River at Rockville just above the city was dwarfed by the freight line improvements. For across the river from Harrisburg the railroad was creating Enola Yard, hub of the new low-grade freight lines which were one of the crowning achievements of the Cassatt era. Here today, thanks to the planning and the pushing and the executive talent of 40 years ago, is the No. 1 freight yard of the world. Enola is an accurate barometer of freight traffic for all the United States. Over its tracks run about seven per cent of the country's total carloadings.

And no wonder. Eastward out of Enola the Cassatt administration built the low-grade freight line which avoids Harrisburg, and which, as we have already seen, also avoids Philadelphia to highball freight toward New York and New England without traffic interference and with grades of not more than 16 feet per mile. Southward runs the Susquehanna line to Baltimore and Washington. Northward is the onetime Northern Central to Sunbury, Williamsport, Wilkes-Barre, Sodus Point, Rochester and Buffalo. Westward runs that great main line over the Alleghenies originally engineered by John Edgar Thomson a century ago, but reinforced during the first decade of this century by four tracking and by freight cutoffs at strategic points.

On the Allegheny slope across the valley from Horseshoe Curve one of these freight cutoffs took shape, using the old alignment of the once state owned New Portage Railroad. A new tunnel was bored at Gallitzin, bringing to four the number of tracks under the summit. Curves were ruthlessly hacked off the line down the valley of the Conemaugh. Where the mountains pressed so closely there seemed hardly room for two tracks blasting powder cleared the way for another pair. And where the main line strikes boldly out of the valley of the Conemaugh and across Westmoreland County into Pittsburgh's back door the engineers set their stakes for a new low-grade freight line to follow the more circuitous valleys of the Conemaugh and the Allegheny and thus cut the eastbound maximum climb between Pittsburgh and Johnstown from 1.01 per cent to 0.3 per cent.

Even then the improvements were not complete, even with a new Pittsburgh station. For in the steel city Pennsylvania had not only a traffic fortress, but its greatest congestion. The main line of the railroad ran right through the heart of the city, with tortuous grade crossings. Even the elimination of these grade crossings in connection with the new station did not provide the freeway for freight for which Cassatt and his engineers were looking. Steps were taken to rebuild the old Western Pennsylvania Railroad along the north side of the Allegheny River into a high capacity freight line, avoiding the Golden Triangle entirely and connecting with the new Conemaugh low-grade line. Before the project had been finished the Pennsylvania had not only built an elevated four-track line through Pittsburgh's North Side, but it had built the Brilliant Cutoff, up to that time the world's most expensive mile of railroad. This connected the main line above East Liberty, Pittsburgh, with the lines on the Allegheny River. It not only allowed a bypass around downtown Pittsburgh for mainline freight, but it brought passenger trains from the Allegheny River lines into the Pittsburgh station over a more direct and convenient routing.

Theo. A. Gay, 156 Van Buren Ave., Teaneck, N. J.

The Susquehanna River near Harrisburg was one of the first natural obstacles encountered by the new Pennsylvania Railroad. First bridge had wooden arches, next one iron trusses. Present 3820-foot four-track stone-arch bridge was opened in 1902. It was part of program to replace important bridges with permanent masonry. Rockville, six miles above Harrisburg, is at east end, Enola Yard near west end. The old Pennsylvania Limited in its gay plumage of cream, jade green, chocolate brown and maroon is shown below coming past Rockville tower.

Edwin P. Alexander collection.

The earth movers were not the only breed of engineers at work on the Pennsylvania Railroad during this portentous decade. The mechanical engineers too were doing their part to see that their system remained one of the world's great arteries of transportation. W. W. Atterbury, general manager under Cassatt and later a great president of the road, was the father of modern Pennsylvania Railroad steam locomotives. It was he who projected the H-6a Consolidation and who carried through the standardization which resulted in the Pennsylvania having so few types of locomotive and so many of each type. This standardization goes further than locomotive types, for even major parts are identical for more than one type. For instance, the E-2, E-3 and H-6 all use the same boiler. The E-6 and H-9 also use identical boilers, as do the K-4 and L-1 and the M-1 and I-1. Many of the engine and running gear parts are identical in various classes of engines.

It was in 1902 that the Class H-6a Consolidation locomotive was born. More than 1000 of these were built by Baldwin alone, and many others took form at Altoona. They were widely distributed, handling heavy freight traffic not only in the Allegheny Mountain districts, but also on the low-grade divisions of the main line. The firebox was wide, giving good grate area with comparative ease of firing.

At the same time the earlier Atlantics on the system were proving very successful. The fast Atlantic City run of 58.3 miles in 55 minutes was being handled by Mother Hubbard locomotives,

4-4-2's of Class E-1, which had an unusually long cutoff in full gear so that they accelerated rapidly. Other classes were designed as revisions, until in 1902 Altoona built the first E-3a, destined to be the beginning of modern Pennsylvania Railroad steam passenger power. Track on the system was so heavy and well maintained that it was possible to safely carry a load of 60,000 pounds per driving axle, and this enabled Atterbury and his men to design a four-coupled locomotive which could do the same work which six-coupled locomotives were doing on many other roads.

The idea was well ingrained under Atterbury that economy in maintenance and servicing should be the prime purpose of locomotive designing. That is why to this day Pennsylvania locomotives are remarkably free of gadgets. The Pennsylvania is not oblivious to new devices. It is just slow and careful about taking on anything which might add to servicing costs until the potential savings are proved. Locomotives are always running somewhere on the system testing one new idea or another, and for all its standardization in regular service the road probably does more testing of new ideas than any other American line.

The Altoona test plant for locomotives dates from this same era. It was built in 1904 and was erected in the Transportation Building at the St. Louis fair as part of the Pennsylvania exhibit. Later it was torn down and removed to Altoona. Tests made on this plant have had a profound influence on American motive power.

It was during this era of improvement that the steel passenger coach came into its own. For this the great New York Terminal was responsible. For safety, steel cars were needed on all through trains which would use the tunnels, and the order for such equipment was so large that it made possible quantity production of steel cars and thus brought them within reach of other railroads.

But a railroad is not only machinery and roadway. Even more important are the men. The Pennsylvania Railroad not only makes its own machinery at Altoona; it makes its own men, many of them also at Altoona. General Atterbury, and many of the other great men of Pennsylvania, in the era of improvement and before and after, illustrate a system of training and organization which is almost military. Atterbury, after graduation from Yale, started as an apprentice at Altoona. No matter what executive talent may be suspected, a Pennsylvania man starts the hard way and fights his way up. The steps may come fast or slow or not at all, but it is well said, "Once a Pennsylvania man, always a Pennsylvania man."

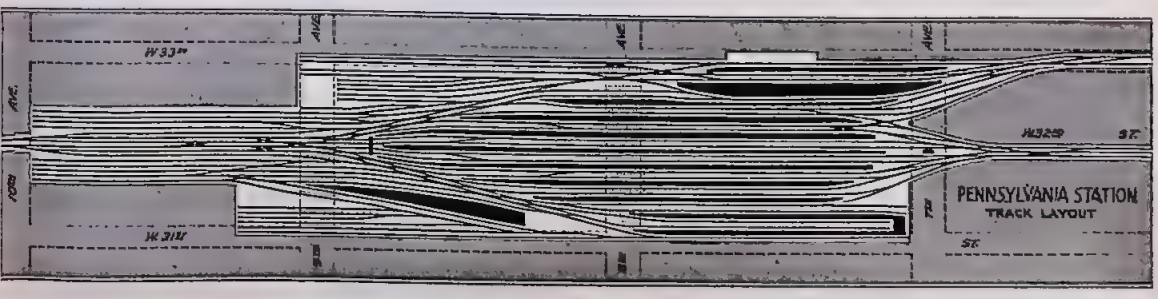
Thus the road has created the careful engineering and sound management which were able, in the early years of this century, to rebuild the property into a completely modern mechanism, each part carefully proportioned to the others, and the whole carefully computed to the job at hand.

Behind one of the Class E-3a Atlantic type locomotives a through train heads westward out of Philadelphia. The time is about 1905. The scene is at the south end of Zoo interlocking with one of the underpass approaches visible at the right.

Edwin P. Alexander collection.

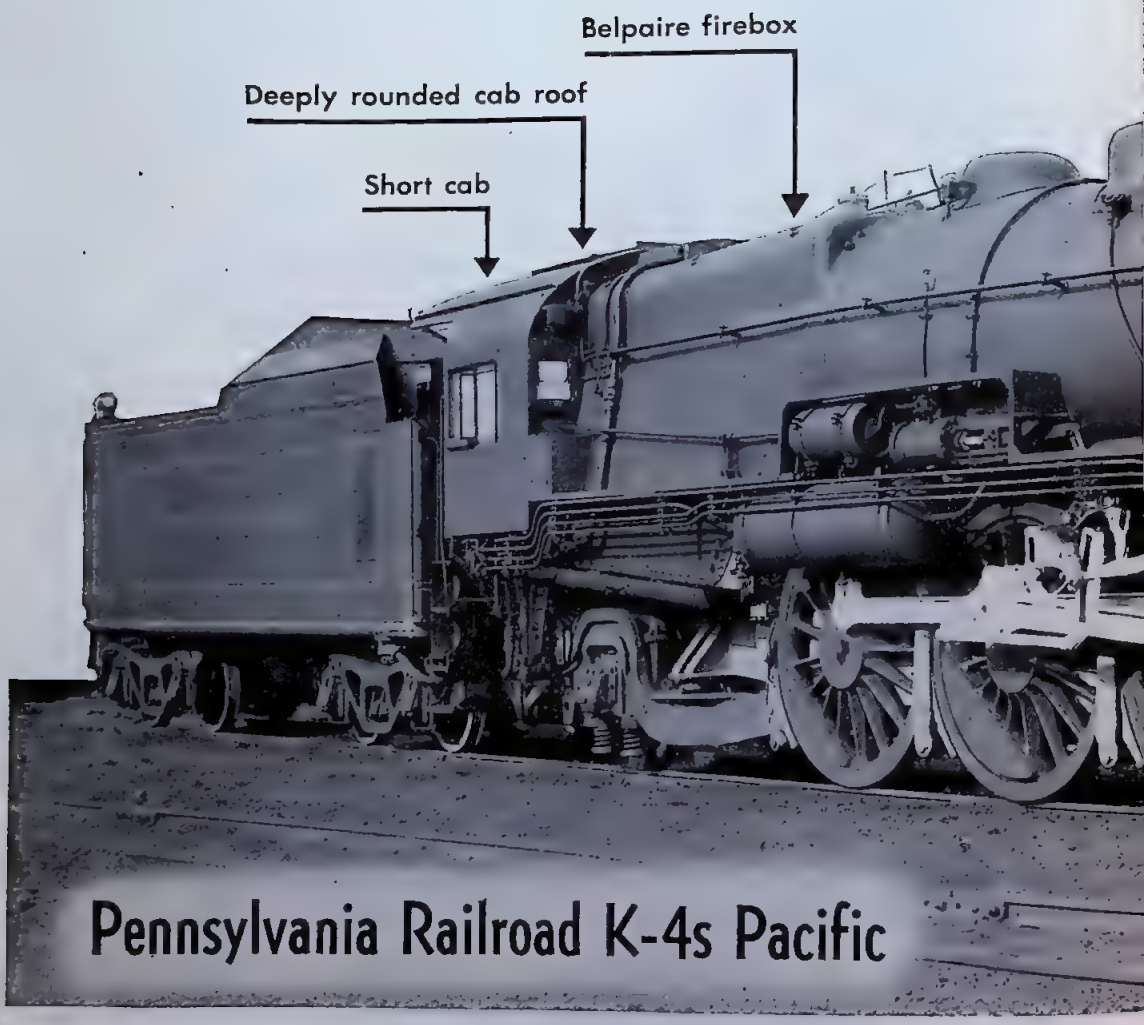
PENNSYLVANIA STATION

Busiest railroad station in the United States. . . . Handled 109,349,114 passengers during 1945. . . . 350,000 passengers a day on four railroads, Pennsylvania, New Haven, Lehigh Valley, and Long Island. . . . Building covers 7.5 acres. . . . Track and layout cover 28 acres. . . . Eleven double-side platforms with over 16 miles of passenger tracks. . . . More than 900 trains a day. . . . 3257 Pullman cars and coaches. . . . Four interlocking towers with 4450 signal units control this traffic. . . . All platforms are at train floor height. . . . Main waiting room is 300 feet long, 110 feet wide and 150 feet high. . . . Train concourse is 475 feet long, 125 feet wide and 100 feet high. . . . Total area of concourse, waiting rooms and the various public passages exceeds 170,500 square feet.



NEW YORK TERMINALS OF THE PENNSYLVANIA RAILROAD

New York connecting RR
Long Island RR to Jamaica etc.
Loop
Sunnyside Yards
Fresh Pond
ISLAND CITY
Long Island RR
Newtown Creek
GREENPOINT
East River
N. 14th St. Terminal PRR
East River Tunnels
12,995 Feet Long
1.5% Grades
Herald Sq. Terminal H&M
6th Ave.
Hudson & Manhattan
MANHATTAN
LI RR
Atlantic Ave.
BROOKLYN
PRR-owned H&M tubes connect Manhattan points with Jersey City & Newark stations of PRR.
NYC
PRR
PRR Desbrosses & Produce Terms.
PRR Freight Term.
Hudson Term. Bldg.
Brooklyn Bridge
Flatbush Ave. LI RR
Battery Site
Jersey City Term.
Bay Ridge Terminal LI and NH
Journal Sq. Sta. Jersey City
CNJ RR
Newark Bay
Greenville Terminal, PRR
Car floats to Long Island RR, New Haven RR, and Terminals.
PRR
Elm. Westcott



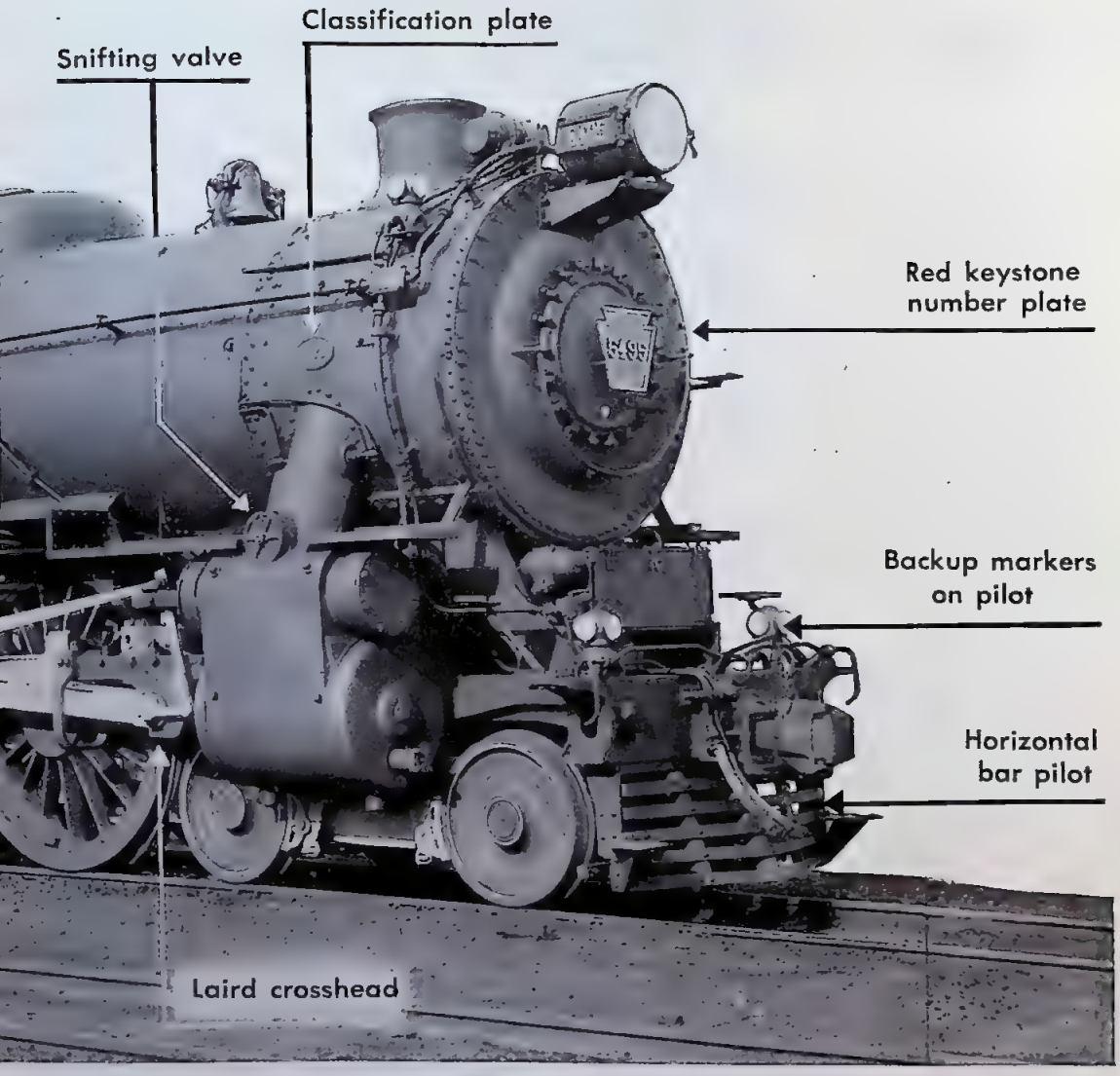
Pennsylvania Railroad K-4s Pacific

The bulk of the Pennsylvania Railroad's steam-operated mainline passenger trains are pulled by Class K-4s Pacific locomotives, one of the country's best known and most successful steam locomotive designs. 424 K-4s's are now in service on the Pennsylvania.

The K-4s, more than any other class, illustrates the individuality of Pennsylvania Railroad locomotives. Labels on photo indicate points to recognize.

The K-4s did not succeed the earlier Pennsylvania Pacifics, Classes K-2 and K-3. Instead it succeeded an Atlantic, the E-6s. In 1910 the Pennsylvania built an experimental Atlantic of large boiler capacity, with the aim of getting the utmost in horsepower for the weight of locomotive, and also the best economy of coal and water. This first E-6 locomotive was very successful, and while it could not start quite as heavy a train as the K-2, the then generally used Pacific, it outperformed the K-2 at speeds above 40 miles an hour. It developed a maximum of 2488 indicated horsepower and turned out a horsepower-hour on 2.0 pounds of dry coal and 17.6 pounds of steam. Eighty of these locomotives, superheated Class E-6s, were built.

The demands of Pennsylvania Railroad's progressive passenger service were for not only



more horsepower at speed, but more starting tractive effort as well—a more powerful locomotive all around. Accordingly in 1914 a new Pacific type locomotive was designed, Class K-4s, and one locomotive was built at Altoona and put through a series of the most exacting tests. Those features of the E-6s which had been most responsible for its success were incorporated, and this first K-4s was practically an E-6s lengthened sufficiently to accommodate a third pair of drivers. The cylinders were enlarged from 23½" x 26" to 27" x 28", with, of course, boiler dimensions increased to suit.

Without doubt, the eastern electrification lengthened the reign of the K-4s by releasing hundreds of steam locomotives for service on other parts of the system and thus lessening the need for new steam power. The two experimental Pacifics of Class K-5 were never duplicated in quantity, and it is only recently that the road has experimented with steam passenger locomotives of new design. Even now, one of the reasonably successful experiments has been the equipping of a K-4s with the Franklin system of poppet-valve steam distribution. Meanwhile the 424 K-4s's, even though designed in 1914, go right on meeting the conditions of 1946 schedules.

Epoch of Electrification

Again the Pennsylvania Railroad expands the capacity of its lines, using electric power in the east

BY A. C. KALMBACH

The eminent railroad electrification engineer sat back in his chair and folded his hands behind his head. He had just been asked an embarrassingly comprehensive question: "Has the Pennsylvania Railroad electrification been successful?"

"The answer is yes," he finally said, "but I am wondering just how to make the point clear. Perhaps this does it: It was the Pennsylvania Railroad electrification which more than anything else kept the government from taking over the railroads in this war as it did in the last. One might even say that if the Pennsylvania's eastern lines had not been electrified we might have lost the war."

Asked to amplify, he continued, "The traffic to the central eastern seaboard was the key to our wartime success, and the Pennsylvania Railroad is the key to this traffic. In the last war it was congestion backed up as far as the Pittsburgh area which necessitated re-routing of traffic to other roads with less capacity, and when they in turn became overloaded the government had to take over. In this war the tremendous capacity of the electrified lines absorbed everything thrown into the central seaboard area and the traffic did not back up. All the way back across the country this capacity had its effect. The railroads were able to do the job, they stayed in the hands of their own management, and we won the war."

The largest passenger traffic in the country is handled over the New York-Washington line, which is completely electrified. The main line to the west, including freight cutoffs, is electrified from New York to Harrisburg and Enola Yard. The Susquehanna River freight line from Enola Yard south to Perryville, Md., is also electrified and gives an electric freight route from Enola to Baltimore and Washington. Near Sunnyside Yards, on Long Island, the Pennsylvania joins the New York Connecting Railroad and over it the New Haven, which is also

A New York bound train about ready to leave Washington Union Station behind one of the GG-1 electric locomotives. Service between New York and Washington is every hour and oftener, New York-Philadelphia is every 30 minutes.

electrified by the same 11,000-volt alternating current overhead trolley system. Thus a continuous electrified route extends down the Atlantic Coast from New Haven, Conn., to Washington, D. C.

The electrification is a tremendous integrated machine, each part in due proportion to every other part. The electric locomotive is not a prime mover like the steam or the Diesel-electric locomotive. It is but a motor, with the prime mover back in the powerhouse. So in designing a large electrification like this it is extremely important to keep the power generators, the transmission lines, the substations, and the motors likely to be on the line at any one time all equal in capacity. There can be no weak link in this chain. Nor can there be any overbuilding, if the capital cost is to be kept at the level of economy. The answer on the Pennsylvania was such careful engineering that there is neither lack of capacity nor any money wasted on excess capacity.

Scoffers often point to steam locomotives pulling trains on electrified lines at times of heavy traffic as a sign of weakness. "The traffic is heavy and the electrics won't handle it. They had to get the good old steam engines to help out." Strange as it may seem, this state of affairs is a sign of the success and the sound engineering of the electrification. The Pennsylvania designed the entire electrical machine to handle normal maximum traffic, and to avoid spending large sums on excess power equipment figured on using older steam locomotives to

H. W. Pontin, Railroad Photographs, 47 Royal St., Allston, Mass.

Pennsylvania Railroad.

A major operation in the epoch of electrification was the construction of new tunnels in Baltimore. Old tunnel at left was converted from double to single track to give more clearance. Two P-5's doublehead freight below on four-track main.

W. R. Osborne, 2331 S. Broad St., Trenton, N. J.

handle any temporary peaks in traffic. The average electrical load is more than 70 per cent of the peak. Thus the expensive electrical equipment is kept working almost all the time, and the investment pays off. Steam locomotives that might otherwise have been discarded furnish the stand-by power.

Why is an electrification? In this case it was in order to expand the capacity of the trackage. Traffic was growing, as it seems inevitably to grow along the country's main arteries. Pennsylvania traffic men have always been able students of the economy of the country. They know the cycles in which production fluctuates. And they knew that even if we had a slump around the early '30's there would again come higher peaks of traffic. The plans for electrification were announced in 1928, with the knowledge that it would not be done in time to help the road over the almost embarrassing peak of 1929, but that it would be ready for the next peak. The only other alternative was more trackage, a frightfully expensive procedure through highly built-up industrial and commercial areas. Little did the Pennsylvania Railroad engineers and officers realize that the next peak for which they were planning their electrification would be a wartime peak far more trying than anything one could foresee.

Electric motive power makes better use of track because it can maintain more constant speed over curves and grades and because it can accelerate more quickly. The electric motor has a short-time overload capacity during which it can draw on the power line for much more than its normal power, the limit being set by the point at which the motors get too hot. The steam or Diesel can produce only as much power as the limit of its boiler or its cylinders.

The electric locomotive makes a still further economy in the amount of power generating equipment which must be built. A steam locomotive of 4500 horsepower must needs have a boiler of similar capacity. A Diesel-electric of 4500 horsepower must needs have a Diesel engine of 4500 horsepower capacity. But in the Pennsylvania Railroad electrified territory a locomotive of 4500 horsepower needs only an average of 27 per cent or 1215 horsepower back in the powerhouse. This is because the powerhouse equipment spreads its horsepower over the entire section of railroad and is at the same time supplying some locomotives running uphill at peak load, others running easily on level, others drifting or stopped in stations, and others which aren't even on the line but are being serviced or held for assignments. Thus Pennsylvania Railroad locomotives and multiple-unit cars of 1,100,000 kilowatts total power need only 306,000 kilowatts of generating capacity, while if these were Diesel-electric locomotives they would need to carry with them 1,100,000 kilowatts or more than three times as much generating capacity. They would not have the short-time overload capacity even then.

All this is the engineering logic back of electrification. It sounds swell on paper. But to make it work a railroad must have tremendous traffic, for the logic of electrification is the logic of the law of averages. And a railroad must also have the courage to spend large sums of money. In the case of the Pennsylvania it also needed the patience to experiment, to endure wrong answers until it found the right ones, for railroad electrification is largely an empirical science and nothing on this scale had ever before been attempted. If you were to electrify your railroad today it would be much easier, for the Pennsylvania has paved the way. But in 1928 when the Pennsylvania plans were announced many a dire prediction was voiced.

Even then electrification was not an entirely new story to the railroad. Before the New York Terminal was built experiments were carried on at great length and the 650-volt third rail system was chosen. The experiments continued even after the terminal was in operation with the result that high voltage alternating current with overhead trolley was finally picked for ultimate mainline electrification, and in 1915 Philadelphia suburban electrification was started with a high voltage overhead line to Paoli out on the main line. This was followed by the Chestnut Hill Branch in 1918, the line to White Marsh in 1924, main line to Wilmington and the West Chester Branch in 1928, and the main line to Trenton and the branch to Norristown in 1930. This completed the electrification of all Philadelphia suburban lines.

The main lines from Philadelphia to Trenton, Wilmington and Paoli were now electrically operated, making a substantial contribution toward the electrification of through traffic, announced by President W. W. Atterbury in 1928. The program was one of the most comprehensive railroad improvements ever announced, including as it did the complete reconversion of the busiest lines of the system not only to electric traction but to a higher traffic capacity.

Pittsburgh. Heavier rail was laid on main line and the world's heaviest, 152 pound rail, was introduced on the New York Division. Cab signaling was extended. Passenger trains were streamlined, air-conditioned and all-room trains built. All told two thirds of a billion dollars was spent on Pennsylvania Railroad improvements in the decade of electrification. This was equal to more than one quarter of the entire value of the road at the beginning of the program.

Electric motive power actually absorbed only a comparatively small slice of this increased investment, but because the locomotive is the symbol of railroad action and power the locomotives stole the show. Or perhaps we should say that one locomotive type stole the show. This is the GG-1, of which 139 are now in service, 95 passenger and 44 freight. With passenger gearing this is a 100 mile-an-hour machine with 4620 continuous horsepower rating. For short periods, as during acceleration or on rolling grades, it can develop top horsepower of 8500. The wheels are divided between two articulated main frames, each containing three driving axles and a four-wheel leading truck.

This final locomotive design was the result of years of experience dating back to the first three-phase motor-generator locomotive built in 1917 for trial service on the Philadelphia-Paoli line. In between had come many other more or less experimental locomotives, some of them built to operate on the direct current New York terminal tracks but designed so they could later be converted to alternating current, for by this time it was certain that mainline electrification would be alternating current. When the mainline program actually got under way in 1928 locomotive experience had solidified into three designs, the P-5 4-6-4 passenger, the O-1 4-4-4 light passenger, and the L-6 2-8-2 freight. Only the P-5 class was built in quantity, 62 for the initial New York-Philadelphia service.

Careful study of their performance during the first year showed that even more powerful passenger and freight locomotives were needed to take full advantage of the electrification. So the P-5 engines were transferred to the freight service, giving it the benefit of higher speed, and the unfinished locomotives of the class were completed with a streamlined cab structure and with various changes to make them more suitable for light passenger service, while at the same time the first GG-1 and an experimental locomotive of 4-8-4 wheel arrangement went into test service. The GG-1 was the better and has since been built in quantity with both passenger and freight gearing until it is practically the standard heavy electric locomotive.

Steam locomotives pulling freight on the electrified lines were greeted with loud cheers by steam fans, but the plans actually anticipated this as a much more efficient way of meeting exceptional traffic peaks than to provide excess generating capacity. The war-born need for more steam power brought forth the 2-10-4 Class J-1, below left, and long-range experiments on steam power brought forth the T-1 4-4-4-4 passenger locomotives, also shown on cover.

Both by R. J. Foster, P. O. Box 375, East St. Louis, Ill.

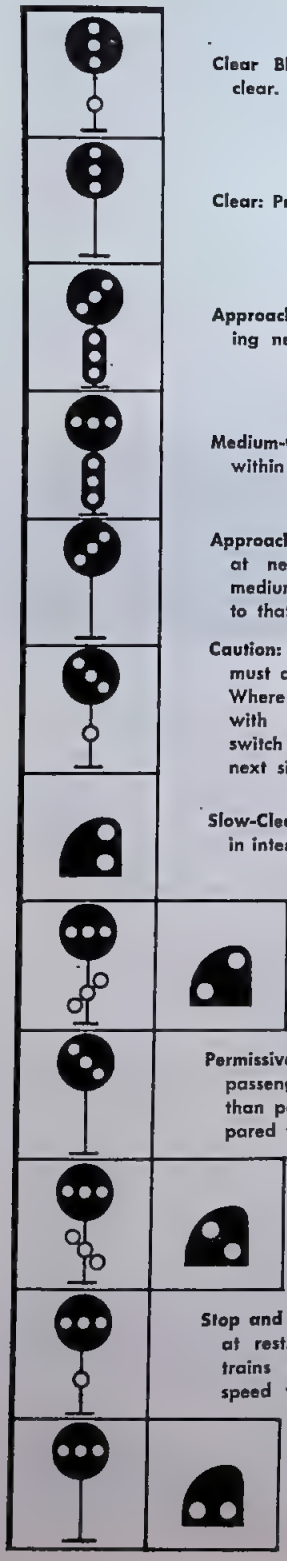
C. A. Brown, Box 128, Rutledge, Pa.

The electrification did not mean an end to experimentation with steam power. The Pennsylvania is always testing new ideas, and the broad policy of experimentation and aggressive improvement, characteristic of the road through all its great periods of development, has been maintained by the present president, M. W. Clement, who came up on the road via the engineering and operating routes and was General Atterbury's vice-president.

The World's Fair locomotive, the 6-4-4-6 Class S-1, was the first Pennsylvania try at the duplex drive arrangement, four cylinders to drive eight driving wheels all in the same rigid main frame. The purpose was to cut the reciprocating weights of rods and pistons, which are difficult to balance. From this experiment came the extremely successful Class T-1 4-4-4-4 passenger engine, designed to haul the same trains which the GG-1's pull in electrified territory, and to run between Chicago and Harrisburg without engine change. The same duplex principle also was used in the 4-4-6-4 Class Q-2 freight locomotive, and both types are being built in quantity. The experimental direct drive steam turbine locomotive is now in regular service and the lessons learned are already being applied to the new duplex turbine. The recent application of Diesels to road power rounds out the picture.

It is a picture of a railroad managed not only with efficiency but with infinite attention to detail and with the courage to take the right action at the right time, even if the action indicated is an expenditure of hundreds of millions on improvements at a time of national depression.

Aspect, Name and Indication of Signals



Clear Block: Proceed, manual block clear.

Clear: Proceed.

Approach-Medium: Proceed approaching next signal at medium speed.

Medium-Clear: Proceed; medium speed within interlocking limits.

Approach: Proceed prepared to stop at next signal. Train exceeding medium speed must at once reduce to that speed.

Caution: Train exceeding medium speed must at once reduce to that speed. Where a facing switch is connected with the signal, approach that switch prepared to stop. Approach next signal prepared to stop.

Slow-Clear: Proceed; slow speed within interlocking limits.

Slow-Approach: Proceed prepared to stop at next signal. Slow speed within interlocking limits.

Permissive-Block: Block occupied; for passenger trains stop; trains other than passenger trains, proceed prepared to stop short of train ahead.

Restricting: Proceed at restricted speed.

Stop and Proceed: Stop, then proceed at restricted speed. Note: Freight trains may proceed at restricted speed without stopping at signals displaying a yellow disk with letter "G" in black.

Stop-Signal: Stop.

Signaling

Position-light signals, which give identical day and night indications without the use of color, were developed by the Pennsylvania Railroad and are the system standard, although some of the older semaphores are still in use. The first position lights were placed in experimental service on the main line near Paoli, Pa., in 1915. The design of the unit has been much improved since then.

The position-light signal has the further advantage that four indications are possible with one signal head, since either a right or left diagonal can be displayed. No moving parts are required, thus cutting down maintenance expense and increasing reliability. The signal is more visible than a semaphore, especially in fog. If any one lamp in a row of three should fail the signal can still be understood.

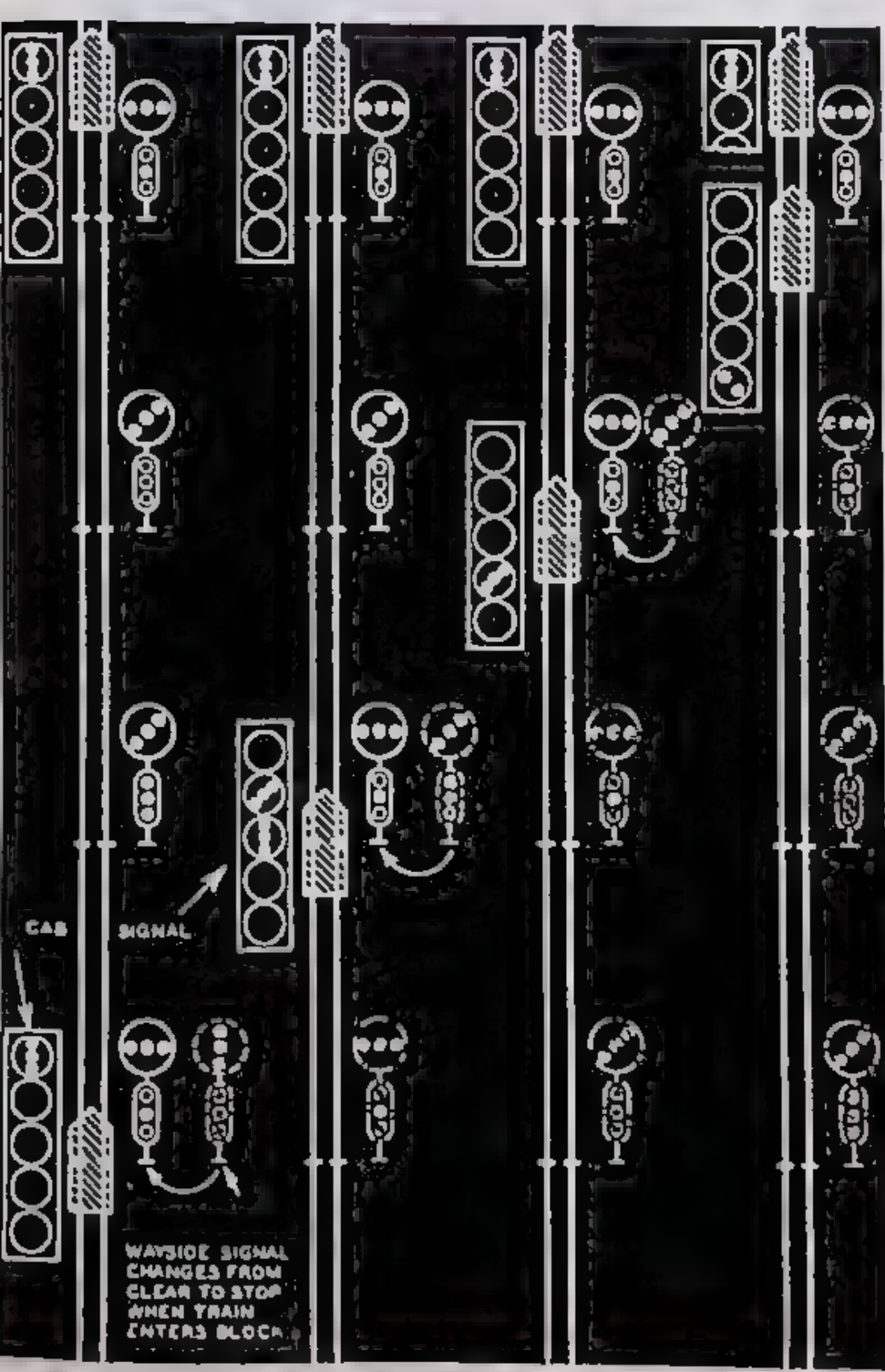
In the last decade automatic block signals have been respaced to provide proper braking distance for higher train speeds, and centralized traffic control has been installed on several sections of the system. Interlocking plants have been consolidated and about 150 of the 500 on the system have been equipped for remote control from other locations.

Cab signals are used on nearly 1300 miles of road and more than 3500 miles of track on the Pennsylvania. This is by far the busiest portion of the system, including the New York-Washington line and the Baltimore-St. Louis line, this last including of course the busy Middle and Pittsburgh divisions over the Alleghenies.

The continuous cab signal as used on the Pennsylvania is a four-indication device which gives the engineman continuous information on the condition of the track ahead and which instantly shows any change in conditions regardless of the position of the train between wayside signals. Thus if a block ahead of the train clears up the engineman is immediately able to resume speed without waiting until he comes to the next wayside signal. Likewise if some restrictive condition develops after a train is in a block the engineman gets immediate warning.

This continuous signal is an electronic device controlled by a 100-cycle alternating current in the rails which is interrupted into various codes to give the four indications.

Above is a typical Pennsylvania Railroad signal bridge with standard position-light signals. Chart below shows the four cab signal indications in relation to wayside signals and a train ahead: Clear, at least two blocks clear; approach-restricting, train in second block ahead; approach, train in block ahead; caution-slow speed, train ahead in the same block.



Railroad for Tomorrow

A BOOK REVIEW BY RICHARD C. OVERTON*

A RAILROAD FOR TOMORROW. By Edward Hungerford (Milwaukee: Kalmbach Publishing Co. 1945. Pp. vi, 323. 32 pp. of illustrations, $5).

A RAILROAD FOR TOMORROW is a serious, thought-provoking challenge addressed directly to the leaders of the American railroad industry and, to a lesser extent, to all who have a stake in the survival of private enterprise. Mr. Hungerford presents in fictional form a penetrating, shrewd, and eminently friendly criticism of selected aspects of the railways as we know them today together with an imaginative, though incomplete, blueprint for 1960 that is crammed with constructive, albeit expensive, suggestions. His positive program outlines the sort of thing he believes the railroads must do on their own initiative if they are to hold their own in the highly competitive postwar world and if they expect to secure co-operation rather than domination by the Federal government. As such it is an earnest plea to private enterprise to start solving its own problems.

Whether by accident or design, this volume is extremely uneven in its treatment of the principal elements that would have to enter into any comprehensive scheme for overhauling the nation's transportation system. For the most part, the subject is approached from the standpoint of the railway passenger and his convenience. Whereas this is an admittedly important consideration and may, as Mr. Hungerford implies, have a prime effect on public opinion about the roads, its overemphasis leads to a subordination of such matters as freight traffic and finance and to an almost complete omission of such knotty but inescapable problems as rates, taxes, and the cost of doing business. Failure to develop these points rather precisely may, I fear, dampen the book's reception by the "top-flighters" in the industry to whom it is primarily addressed.

Nevertheless, despite its selective and discursive nature, *A Railroad for Tomorrow* should be required reading for every railroad president and director who effectively determines the policy of his company or his industry. Its moderate but urgent warnings, especially in respect to the railways' lack of imagination in matters of service and human relations, deserve open-minded consideration on the part of those who are in a position now to do something about it. Furthermore, the many specific suggestions, particularly those concerning consolidation, terminals, transcontinental service, labor, and equipment are entitled to careful scrutiny by the railroads.

* * *

In simplest terms the plot of the "story" concerns a dynamic genius named William Wiggins from Maine who in the mid 1940's found himself in charge of a short railroad in his native state. Having long pondered the weaknesses of our transportation situation, he sets about testing a sheaf of new ideas which he believes will not only produce better service than ever before given to the public, but will be sound economically in the long run. His schemes succeed, and before long Wiggins gains control of all the railroads in New England; meanwhile he has had an opportunity to help reshape the Federal regulatory system by virtue of his position as a senator. By 1952 he becomes Director of the United States Railroad, a sort of giant holding corporation of national scope. This organization, operated as a private enterprise with a Federal charter, is guided by a joint directorate (somewhat like the Federal Reserve Board) representing management, labor and the public. It controls all American railways which, during 1945-60, have been rearranged into twenty-one major systems and modernized as to plant, service and equipment so as to render the best possible service to the public. In the meantime, trucks, busses, barges, planes and pipe lines have been assigned roles according to their relative fitness and economy; U.S.R.R. co-operates with them all under a benevolent system of government regulation.

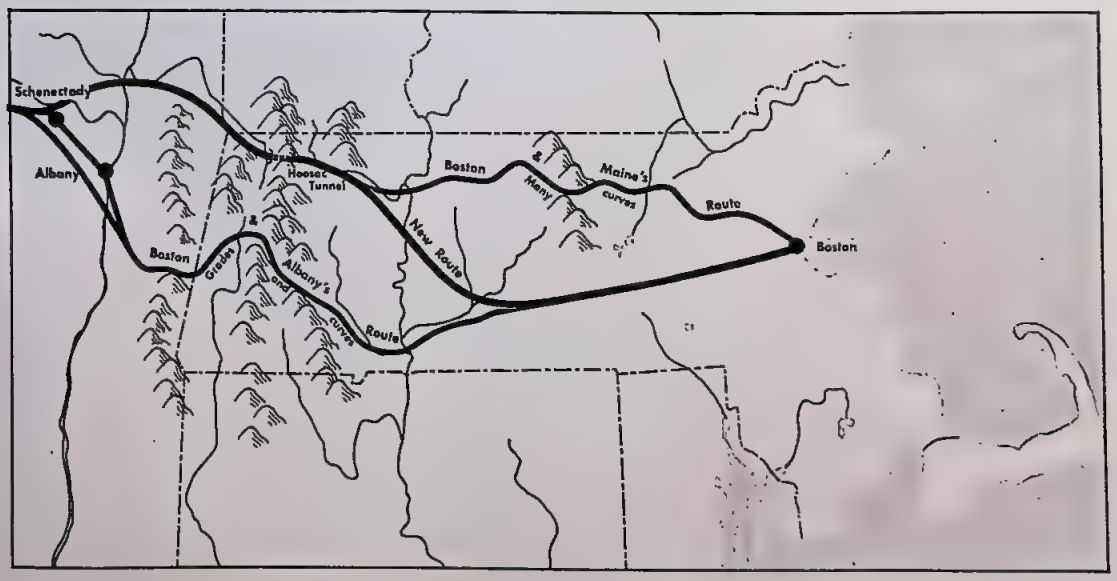
The relative emphasis that Mr. Hungerford places on the various aspects of this story may perhaps be best summarized by noting the space he allots to each topic:

* Professor of Business History, School of Commerce, Northwestern University. Author of "Burlington West" and other railroad books.

1. Plans for consolidation of railways into 21 systems and for the correlation of passenger service over these lines 101
2. Simplification of metropolitan terminals 82
3. Co-ordination of the various types of carriers 41
4. Motive power and freight equipment 26
5. Labor relations 24
6. Passenger equipment 21
7. Administration of the U.S. Railroad and the role of the government (also touched on under Item 1 above) . 15

As this breakdown indicates, the program for consolidation, together with the operation of transcontinental passenger service, receives Mr. Hungerford's greatest attention; they are matters to which he has obviously devoted long and careful thought. The reasons he gives for the allocation of the various railways of 1945 to his 21 systems of 1952, for example, are logical and explicit. Briefly, he proposes unification of the New England, Florida, and Texas roads into terminal or regional systems. Similarly, he would form three terminal systems on the West Coast, each of them extending roughly eastward to the Rockies; a new Northern Pacific, embracing all the present lines in Washington, Idaho, and Oregon would serve the Pacific Northwest; the revived Central Pacific would handle all business between Salt Lake City-Ogden and San Francisco, while a truncated Southern Pacific (combined with the Far West lines of the Santa Fe) would connect Southern California with the east Texas gateways. For the remainder of the country, 15 semi-competitive regional systems would be established; east of the Mississippi the well-known Four Party Plan would be adopted with few changes. Unfortunately, *A Railroad for Tomorrow* does not include maps of the proposed systems nor any complete list of their components, but the text sketches the outline in enough detail so that the pattern is clear to anyone well acquainted with the location of the present large companies. Most of these suggested changes could be accomplished by utilization and exchange of existing facilities; consequently the proposals are reasonably practical from a physical and financial standpoint. Furthermore, there is much to be said (and much has been said by all shades of experts) in favor of consolidation at about the strategic level Mr. Hungerford proposes. His plan certainly seems as feasible as any, and far more original and logical than some. At any rate, it is definitely within the realm of possibility provided, of course, that the gods of Greed, Pride, Tradition and Inertia so valiantly excoriated by the author could be overcome. Less convincing is the specific proposal of a

Under the Hungerford plan many main lines are rearranged to take advantage of favorable combinations of railroad. For instance, in New England the Hoosac Tunnel portion of the Boston & Maine's Boston-Albany line is combined with the easy eastern portion of the Boston & Albany. The book includes nine main line and terminal maps.



totally new line from Pittsburgh to New York; there is not a scrap of evidence as to cost or savings, although one might readily agree that it is too bad that this "dream railroad" did not become a reality long ago. Mr. Hungerford's detailed suggestions for transcontinental passenger service are far more practical; they are convincing as well as appealing. The sample schedule (dated September 1, 1960) and train-route maps admirably illustrate his ideas, and one wonders which of the evil gods has prevented the adoption of some such scheme long before this.

With the assurance of a man who has been there and knows what he is talking about, the author devotes about a quarter of his book to the simplification of the terminal situations in New York, Boston, Buffalo, Cleveland, Detroit, Cincinnati, Baltimore, Washington, Chicago, San Francisco, Los Angeles, St. Louis, and New Orleans. Helpful maps illustrate the more important projects and there are diagrams of the new stations designed for New York and Chicago. From the standpoint of convenience and service, one can hardly take issue with Mr. Hungerford. He demonstrates all too clearly the results of poor planning and selfishness on the part of individual roads, and makes eminently appropriate suggestions for each city he discusses. But just how passenger revenues, or the intangible returns from public approval, would pay for these fabulously expensive changes remains a mystery.

In his 26-page chapter on motive power and freight equipment, Mr. Hungerford is more cautious. He reaches the sensible conclusion that there is an appropriate place for steam, Diesel, and electric locomotives, and wisely allows ample room for the technical improvements that may take place between 1945 and 1960 (such as the gas-turbo engine).

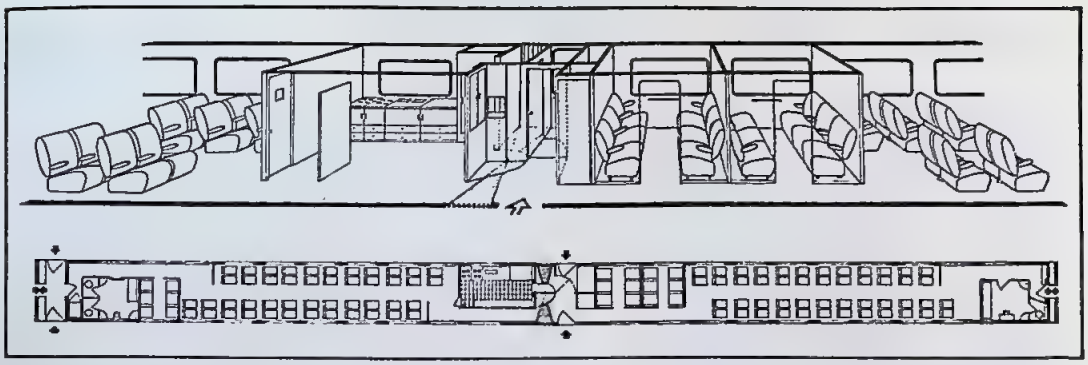
In the 20 pages accorded passenger equipment, Mr. Hungerford is at his best; he knows well what passengers want, and his suggestions should be carefully pondered by designers and buyers of new cars. His emphasis on adequate (though modest) eating facilities appears justified, and his personally-designed double-unit articulated coach presents a practical and attractive variation of the most modern equipment. Throughout the book there are a number of illustrations of new passenger cars; Mr. Hungerford stresses the fact—to which few railroaders of 1945 would take exception—that only by offering really comfortable, streamline equipment can the roads hope to attract their share of the future overland passenger traffic.

Mr. Hungerford's short but meaty chapter on labor is full of good horse sense. With consummate tact and even-handedness he analyzes the origins of lack of confidence existing between labor and management in 1945, and describes the happy day in 1960 when working relations between the two are as simple and direct as those between a country storekeeper and his clerks. Gone are the elaborate contracts and agreements between railroads and employees, gone too are feather-bed rules; on the other hand, basic rates have been increased for nearly every class of worker, and a standard scale of pay is in effect which takes account of the difficulties and responsibilities of each job as well as the number of years in service. Although this chapter, like some others, is sketched only in broad strokes, it should be reread many times by both brass hat and griever. Probably the final chapters, covering some 15 pages, should be considered in connection with the comments on labor. They describe the atmosphere and procedure of the joint board which guides the United States Railroad, and point out what might quite conceivably take place if men of good spirit could be persuaded to work for the common objective of better public service rather than to strive for their particularistic ends.

The foregoing "horseback survey" does scant justice to the wide range of topics Mr. Hungerford covers in his book; countless minor matters are mentioned in greater or less detail. One is almost tempted to say that the author tries to cover too much and in so doing develops only a few subjects thoroughly. But, as Mr. Hungerford says, time is short and perhaps that is why he has hastened to present as much as he can now without attempting to develop each topic.

* * *

The way in which this story is told is as ingenious as the plot itself; *A Railroad for Tomorrow* is, in fact, something of a drama in prose. Darwin Kenton, a reporter for the London *Times* of 1960, visits America in that year to see and report upon Wiggins' accomplishments. During his stay he travels about and talks not only with Wiggins himself, but with his secretary and right-hand man, Max Ensler, and a dozen other railroaders who have participated in the stirring events of the preceding 15 years. The narrative consequently is put together from descriptions of Kenton's



Edward Hungerford designed his own two-coach unit for daytime passenger service on the railroad of tomorrow. Outstanding feature is a kitchenette in the center of each double-car unit from which light meals are served to passengers at their seats. The spacious private rooms may be reserved for the use of family or businessmen's groups.

trips, excerpts from his report to the *Times,* extensive conversations with the people he meets, lengthy reminiscences by Wiggins and Ensler, and a liberal sprinkling of factual footnotes and editorial asides by Mr. Hungerford in person. This unique method of presentation permits the author to shift scenes from one end of the country to the other and from the past to the future and back again at a moment's notice. It also allows him to philosophize, criticize, and prophesy from a healthy variety of viewpoints and to infuse perspective and rather delicate shading into a discussion that covers an amazingly wide range of time, places, and topics. Only when the narrative verges on the melodramatic, as when Wiggins contemplates suicide or at the scene of his death, does the mechanism clank.

At times, however, as is perhaps inevitable with such a potentially cumbersome device, one becomes confused as to just who is speaking at the moment or just when and where this or that development is supposed to take place. A more serious criticism in respect to presentation is the fact that the major topics (such as consolidation, terminals, and so on) are not treated consecutively, but are scattered throughout the book so that it is difficult to follow a given train of thought to its logical conclusion. These technical defects and the lack of an index or a table of contents could easily be cured, and it is to be hoped that they will be in later editions. If they are, the author's ideas will have a far better chance of reaching their mark. As it is, the fictional story alone preserves itself intact, and whereas this is a meritorious dramatic accomplishment, it tends to obscure the moral of the tale which is, I assume, the more important part.

No comment about *A Railroad for Tomorrow* would be complete without a special word about the author, for the book is very much a part of his own personality. "Ed" Hungerford, as he is known to his countless friends across the land, is a trained and keen observer, not only of the railways he has watched and thought about for more than 40 years, but of the men and women who operate them and of the ideas and ideals that activate the industry. Few men of half Ed's age possess his unquenchable enthusiasm about the American railway as a living institution; few men, if any, have traveled so widely over the nation's rails. As a producer of superb exhibitions at Baltimore, Cleveland, Chicago, and New York he has probably done more than any living person to dramatize and publicize the industry, past and present, as a great national enterprise. He has been a prolific writer on the subject, and whereas some of his volumes may leave something to be desired in respect to thoroughness or the historical and technical accuracy of their details, they have, like his dramatic productions, unfailingly caught the spirit of the man, event, or development described. He has amply revealed his uncanny sensitivity to opinion in and about railroads and has given full proof of his fertile imagination and independence of thought.

Ed Hungerford's basic plea is simply that some modern plan be devised by the railways themselves before it is too late. Both because of what it says and of the man who wrote it, *A Railroad for Tomorrow* deserves a wide and cordial reception.

RUNNING EXTRA

In keeping with past columns we'd like to introduce two more members of the TRAINS crew. On the left is Frank Wolf, a genial easy-going fellow in the composing room. Frank has been a part of the crew for more than two years, and handles the lockup of all the forms prior to their being run on the presses. On the right is Frank Grabowski, expert composing room foreman. It is his job to see that all copy is set into type, made up into pages, and on the presses in time to meet the mailing dead lines. He delegates the various jobs to the other members of the composing room staff so that the volume of work is sufficient to keep the presses rolling for 18 hours a day. Both of these fellows have had it rather ruggged these past few years, but have worked hard and ungrudgingly, putting in long hours in the composing room.

Theirs is not an easy job, one of the requisites being that they must be able to read type in galley form, upside down, and without the aid of mirrors. After the copy has been set up on the linotype machine, it is made up into page form, together with the half-tone cuts (or pictures), zinc plates, logos, and larger display type. These page forms are then taken, eight at a time, and placed on a metal table called a stone, where they are securely locked in a metal frame, or chase. This chase is then placed on the bed of the press ready for printing.

It is a never-ending challenge to the compositor and lockup man to be able to lock up a form so that a minimum of changes are necessary to make the margins of all eight pages line up uniformly.

This month we bid good-by to our shop superintendent, Bob Fakler, who has been with us for several years. Bob is starting a job printing plant of his own on another floor of our building. Glenn Parker is taking over most of Bob's former responsibilities and a few new ones. Parker is an active young man who deserves a more detailed mention in this column later on. Beside his printing and publishing experience he is active in civic organizations and is currently president of the Milwaukee Junior Chamber of Commerce.

Railroad

Lincoln J. Carter

In the February TRAINS D. W. Yungmeyer's article on "Railfans' Saturday Night" asks if anyone remembers Lincoln J. Carter. Of course, I do! Apparently there are others who do, too, for every year I receive a dozen clippings from various friends of mine all around the country relating to him. Mr. Yungmeyer evidently was thinking about the scenic effect of the approaching locomotive from "The Heart of Chicago," which reappeared a great many years later in one of the Shubert Winter Garden shows featuring Al Jolson. Trains must have interested Dad quite a bit, for they appeared in two other famous effects of his: the race between an automobile and a train from "Bedford's Hope" (1904); and the life-sized freight that crossed the stage to provide a climax for "The Fast Mail" of much earlier date. These shows had the distinction of being the first ever produced showing trains and automobiles on the stage. From this you can see that I come by an interest in trains naturally.

Lincoln J. Carter Jr., South Bend, Ind.

Progress and the Century

During the past several months I have had the opportunity of loitering around Harmon, N. Y., while the Central's blue ribbon fleet pulled in to start its dash to the great cities of the Midwest. I am given to careful consideration of the changing world we live in when I see the premier train of America, the *20th Century Limited*, being whisked away by a Diesel. I have known the *Century* since a boy, and a sight like this makes me realize more than ever that we live in an age of progress. Apparently the Diesel is doing a good job of it, in spite of the fact that I hear the Central has some 6000's that will clock 120 miles an hour with 18 Pullmans on a test run.

J. D. Appleyard, 1486 Lincoln Ave., Lakewood 7, O.

Hopper Cars

A large part of the local work on our job is done at the soybean mill and elevator of McMillin Feed Company, Gibson City, Ill. For the past month or two, because of the acute shortage of grain box cars, McMillin has been releasing 25 to 40 cars of shelled corn per day loaded in coal cars. High-grade, grain-tight, 50- and 70-ton hoppers are being supplied by the NKP which handles the movement in interchange from the IC to destination at Decatur, Ind. A 50-ton hopper carries about 40 tons of corn. In bright sunlight the golden yellow grain adds quite a splash of color to ordinarily drab coal equipment.

Jim Sullivan, Gilman, Ill.

First-Class Coach

I wonder if you might not change the name of the magazine from TRAINS to "Tin-Cans" in five years or so. Judging from the complete absence of steam engine news and the overwhelming popularity of the Diesels, this might be necessary. Nothing can equal a steamer's whistle in the night and second best for me is still the grunting of a freight engine starting a long string of cars. The finest in passenger equipment to my way of thinking is the open end observation car with polished rails. However, there is no use trying to stop progress. But I wonder if the railroads are not making a mistake in one way. I think that most first-class business will go to the air lines. They are faster, and most first-class travel is business travel anyway, and businessmen are

Mail

always in a hurry. So why put any money into first-class equipment which will only be used in bad weather when air lines are grounded? When it becomes necessary for this type of passenger to use the railroad he will be willing to settle for any equipment. And even with the best he will probably complain about service. I don't think the businessman can be won back to train travel. Another group it is foolish to spend money on is the vacationing tourist. Most of them travel by automobile, and more will use automobiles after the return of new models. Instead of spending the new equipment money on streamlined mainline trains, why not put it into better service on branches to smaller towns where air lines cannot penetrate? An outright attempt to knock the trucks out by express freight service to small unimportant towns would yield considerable business. Many of the standard coaches could be remodeled into wonderfully comfortable cars. I am thinking especially of those fine cars on the C&NW Viking called lounge coaches. Cut out first-class equipment such as lounges and observation cars and turn it into coach class. The carriage trade is flying, so let the coach passenger find out how it feels to be a big shot without paying double fare. Most parlor cars are half empty now anyway. There are plenty of people up in the green plush who would like to go back for a bottle of beer, but they are thrown out abruptly on every railroad I've been on with one exception—the good old C&NW where a coach passengers money is good in most bar cars.

I wonder what you think of this?

Donald H. Kotz, Kenosha, Wis.

No Technical Material

I don't know what the other readers of TRAINS desire, but personally I think articles dealing heavily with mechanical aspects of equipment, such as the turbine locomotive article in a recent issue, should be left out and dealt with by the several strictly technical magazines. I should like to see TRAINS publish material, just as it has been doing, on interesting trips, descriptive of various railroads or portions of railroads, but not too technical descriptions of equipment. Also articles on operations of the various departments of railroads.

George Kottke, 5440 33rd Ave. S., Minneapolis 6, Minn.

Railfans' Grill

On a recent trip to the West I encountered a railfans' restaurant in Colfax, Calif., 2418 feet up in the Sierra Nevada Mountains. Situated on alternate U. S. Highway 40, and less than 300 feet from the tracks of the Overland Route of the Southern Pacific Railroad, there is a wonderful grill which displays a unique collection of action shots of modern American locomotives arranged in frames 2 x 3 feet. Among others, the pictures show the steam turbine locomotive of the Pennsylvania Railroad. A night photo of the streamliner *City of San Francisco* stopping in Colfax for water is quite unique because it offers the rare sight of a Diesel-electric train using a steam helper. But not only the walls of this restaurant would delight a railfan; through two large show windows one could see the lively procession of Southern Pacific trains and of some of the largest locomotives ever built going by. Considering the many eating places all over the country, uninteresting because of their cold uniformity it is indeed refreshing to experience something original.

F. Petersen, Reno, Nev.

SECOND SECTION

About the nicest thing that happens to us is having visitors. Most of us on the staff are working on TRAINS because we've had a love for railroads all our lives and when a fellow pops in who has the same interests, we have a chinfest about the railroads in his part of the country. One of our recent visitors was Howard Fogg. Right here we'd like to mention that you should remember that name. Howard is a railroad artist and a good one. He hails from Illinois originally but is now living in Summit, N. J.

Howard was recently discharged from the AAF after having flown 76 missions over Germany and western Europe as a fighter pilot. Like many another pilot we've talked to, he says that flying was a war job and one that he wanted to get away from as soon as possible because it merely whetted his appetite for more railroading. Mrs. Fogg has given Howard her blessing in his chosen career of railroad artist. Incidentally, Mrs. Howard is a lovely brunette with brown eyes. Howard is dark complexioned with steel-gray eyes. Their 5½-month-old "blonde tallow pot" as their first born is referred to, has blue eyes and Howard is at a loss to explain this (m'good feller, 'tis said that *most* babies are born with blue eyes).

Getting back to Howard Fogg's railroad paintings, we want to repeat, they are good. In fact so good American Locomotive has retained Howard to do a series of paintings for them. Having a great admiration for Peter Helck, Howard says his one ambition is to attain the recognition of Helck. We think he has an excellent start.

TRAINS Album of Railroad Photographs, No. 13, the Baltimore & Ohio Railroad, is now ready. Albums Nos. 14 and 15, covering the Erie and the Great Northern respectively are on the way. If you have already ordered the Erie or Great Northern albums and have not received them it will help immensely if you don't write in asking about them. Just as soon as we have them ready they'll be sent to you. Incidentally, the Santa Fe Album, No. 12, is now out of print. It will be a couple of months before we can reprint that one. (Anyone know a good pressman looking for a job? We could use another good one and probably keep him busy on albums alone.)

Have you any color transparencies suitable for one of our front cover illustrations? Let us see them. We'll pick out any we can use and send a check right away. We will return the others as soon as possible. Be sure they are sharp and suitable for reproducing as large as 7 x 10½ inches after we enlarge them. Incidentally, if you are a railroad photographer in either color or black and white, send for our photo bulletin No. 3. It tells how we make payments for pictures, the kind we need most, and gives a tip or two on getting good quality.

We expect to announce the winners of TRAINS' Itinerary Contest in the May issue.

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No longer seen are covered roundhouses such as this old one at Lowell, Mass. The picture was taken in 1855.

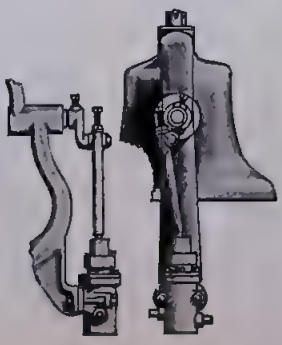
End of the Train

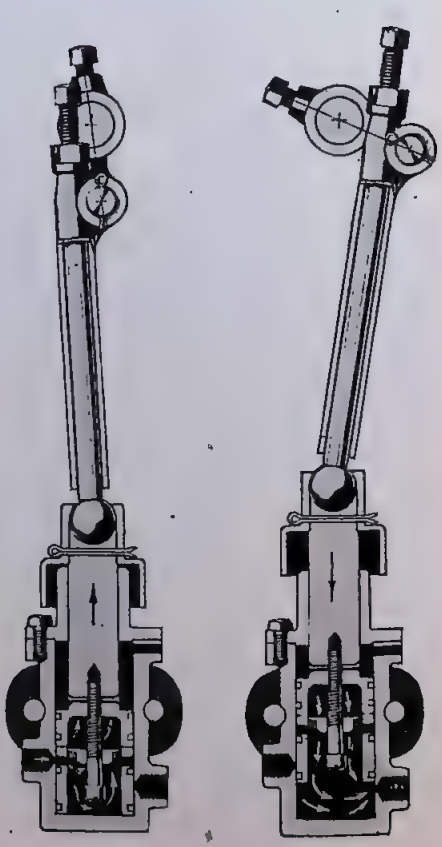
The caboose is said to have more synonyms in railroad slang than anything except a locomotive. Crummy, bouncer, buggy, hack, cage, hut, way car, cockloft, dog house, monkey house, and parlor are a few of them. Early cabooses were just box cars with a clerestory window punched through the roof. Their side doors caused the death of many a trainman where clearance was insufficient. Next came the all-wood, four-wheel platform buggy, with its cannon ball stove and hard wooden berths.

An intermediate caboose was the wooden way car with steel understructure and two four-wheel trucks. The starting jerk on a caboose when the locomotive takes up the slack of a mile long train can throw a brakeman from the observation window aloft, which is one reason the most modern cabooses have side bay windows on the deck level. From the new style bay window the observer can spot a hot box on a straightaway as well as on curves. Running water, refrigerators, improved heating and cooking stoves, and deep stuffed bunks may lessen the colorful tradition of the caboose, but the men in it won't complain.

How Bell Ringers Work

The bell on a modern locomotive is operated by a simple reciprocating machine like the Viloco bell ringer shown here. This type is attached to the bell frame and controlled by a graduated valve in the cab. The drawings show front and side views of the ringer on the bell frame, and internal views of the machine in operation. Compressed air taken from the main reservoir of the air brake system enters through the upper opening, pushing the piston upward. At the end of the piston stroke the upper opening is automatically covered and the lower opening is exposed, thus letting the compressed air out and allowing the piston to return. Other types of bell ringers are attached to the bell itself or to the top of the clapper. The principle of operation is approximately the same with all types of ringers.





Gauge . . . and Guess

In the vast ancient wastes of North Africa, south of Constantine, lies the ghost city of Timgad. Here, some 19 centuries ago, the caravans of Roman merchants en route to Egypt halted on their way from Tunis, Carthage, and Algiers while the caravans were provisioned and equipped with legionnaires for protection on the trek across the Arabian desert.

Today, in the ruins of the ancient city are the remains of several of the six roads which intersected the city. They are paved with enormous hexagonal blocks of blue limestone; and cut into them, about four inches deep, are ruts for the wheels of countless chariots, carts, and wagons. Ruts were cut into the roads for the use of vehicles because it was far easier to make ruts smooth and level by putting sand in them than to attempt to level the entire width of the road. The complete absence of other ruts indicates a regularity in axle width of all vehicles traversing the roads. Actual measurement here as in Pompeii reveals the distance between the ruts to be just under 4 feet 9 inches.

It has been suggested that these standardized vehicles impressed the roads wherever the Romans traveled as war and trade expanded the Empire, and that eventually they may have been responsible for the present-day railway gauge. (One scholar cites claim to proof that the identical rut gauge was in use in roads built 2000 years B.C.)

One hundred years previous to the arrival of the steam locomotive, English collieries were using flange-wheeled vehicles moving over rails which were surfaced with two inch wide iron plates. Flanged wheels had been in use since medieval times, although the flange had always been on the outer rim of the wheel. The gauge of the rails, however, was almost the same as that of the ancient Roman ruts—4 feet 8 inches.

When George Stephenson was commissioned to mechanize one of these colliery tramways (so called after their inventor, Outram) at the Killingworth Colliery, he retained the same gauge, possibly because of the expense of changing it, and of the dubious attitude engendered by the revolutionary substitution of steam for animal power. Stephenson did, however, modify the wheels of his vehicles by fitting the flanges to the inner rims of the wheels where they ran inside the rails.

When Stephenson built the first public railway, between Stockton and Darlington, he increased the rail gauge to 4 feet 8½ inches; the extra half inch lessened frictional wear on the wheels and allowed higher speeds. His railroads with this gauge grew to such an extent that Parliament enacted a prohibition against the use of any other gauge in Great Britain.

The earliest American railroads had gauges of a variety from two to six feet; but Congress, in Lincoln's time, settled the gauge of the Pacific Railroad, from the Missouri River to the Pacific Ocean, at 4 feet 8½ inches. This measure so affected other railroads, that a general abandonment of individual gauges in favor of standard gauge followed.

It is a curious thing to reflect upon the possibility that our modern railroads thunder over rails whose gauge was decided by a craftsman over two thousand years ago who perhaps worked out the best axle width for animal power.—*Joe Fox.*

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Rail Detector Car

Anyone who has tried to bend a piece of wire back and forth to break it will understand how a small fissure can eventually break right through a rail. Southern Pacific takes the precaution of testing for flaws on all mainline rail twice a year with its own rail detector cars. The principle of operation is the same as that of wire recording; as the car moves along at five miles an hour, a magnetic flux is passed through the rail by powerful electromagnets. If the rail has a crack, a joint, or a hidden fissure, the magnetic force has more difficulty in passing through the rail. Delicate instruments in the Detector Car record this on tapes, and the machine also squirts a spot of paint on the rail to mark the defective place. Where the indicator shows serious damage, the car stops and the crew makes a double check. The Detector Car is so sensitive that it locates and records molecular deficiencies long before they become dangerous. In this way maintenance crews can replace weak rail before damage is done. Southern Pacific's cars somewhat resemble the well-known Sperry Rail Car that services many roads, but they are smaller.

Victorian Speed

The influence of Queen Victoria upon the history of railroading will probably be felt as long as anecdotes in regard to her are extant. The following excerpt from a letter written in 1852 reveals a sly sidelight on the manner in which queens, like children, are protected by the theory that "what they don't know won't hurt them."

The queen, whose first railroad venture was in 1840, when railroads still operated rather slowly, had ordered that the train in which she was to ride would maintain a regular and moderate speed. In explanation of this order, a court official wrote the railway company,

"This order has probably arisen from one of the Directors telling Her Majesty last year that they had been driving a train at the rate of sixty miles an hour, a gratuitous piece of information which very naturally alarmed Her Majesty, although it was probably incorrect."

There's More Than Meets The Eye in Passenger Comfort!

Look *below* the floor line for the source of gentle, jolltless starting and smooth, swayless running.

There, under the great majority of modern passenger cars and streamlined trains, you also will find the source of continuous high-speed on-time performance and low maintenance — in journals equipped with Timken Roller Bearings.

There is your cue for future developments in competitive passenger traffic. The Timken Roller Bearing Company, Canton 6, Ohio.

Outstanding Record of the R. F. & P.

Most of the traffic interchanged between the Pennsylvania and the Baltimore & Ohio on the north, and the Atlantic Coast Line and the Seaboard on the south, passes over the lines of the Richmond, Fredericksburg & Potomac Railroad.

The freight tonnage of the R. F. & P. during the recent 4½ war years about equaled that for the preceding 14 years. An important factor in making this tremendous traffic movement possible was the addition to its motive power equipment, in 1943, of ten Lima-built 2-8-4 steam locomotives.

LIMA LOCOMOTIVE WORKS INCORPORATED

LIMA LOCOMOTIVE WORKS, INCORPORATED, LIMA, OHIO

ONE HUNDRED YEARS

1846 - 1946

The "John Bull," built in 1831—America's oldest original locomotive

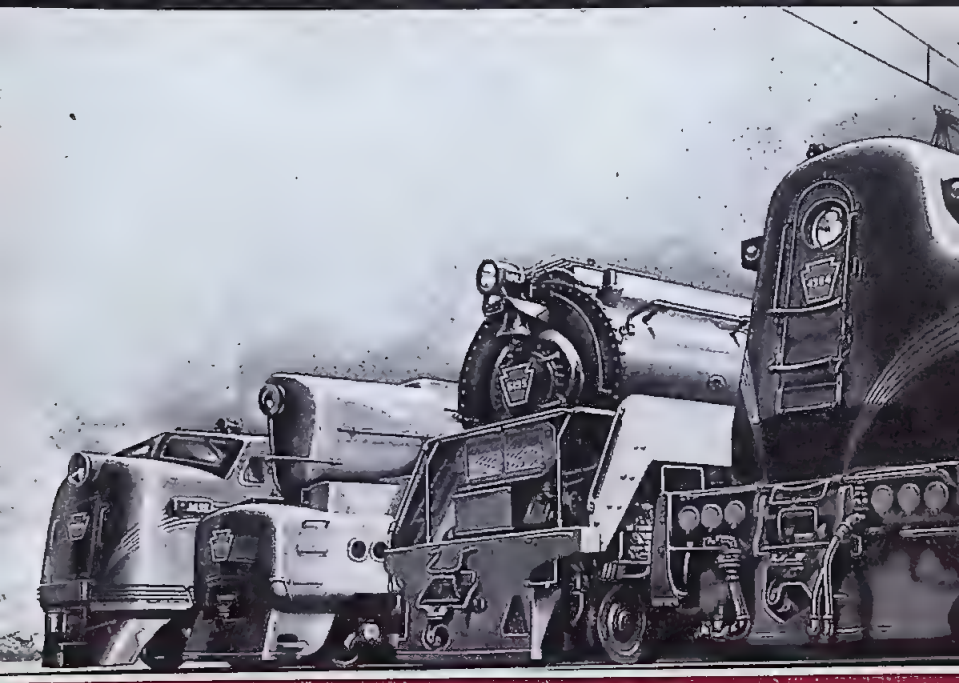
A Pennsylvania Railroad locomotive of 1865

Power in 1902 for the Pennsylvania Special, forerunner of the Broadway Limited

THIS YEAR—1946—marks a century of progress by the Pennsylvania Railroad in service to the American people. Reflecting the tremendous industrial growth of the Country itself, this service has steadily advanced from a few trains a day to 1,340 passenger trains and 3,170 freight trains daily, operating over 10,114 miles of line extending from the Atlantic to the Mississippi. Now, as we prepare to move into a second century, our combined research, engineering and shop facilities are producing new trains, new locomotives, new cars, new comforts and new technical achievements . . . to add another chapter of transportation progress that has continued for one hundred years.

PENNSYLVANIA RAILROAD

Serving the Nation



1846 1946

One Hundred Years

OF TRANSPORTATION PROGRESS

PENNSYLVANIA RAILROAD

BACK in 1846, public-spirited citizens of Pennsylvania, foreseeing the vast westward expansion of the nation, rallied to a cry for a railroad line across the state to connect with other railroads which were opening the West.

To the north the Erie Canal had long been in operation, attracting to its thoroughfare much trade and traffic that could have moved through Pennsylvania—and to compete with it a railroad was being built in the same region.

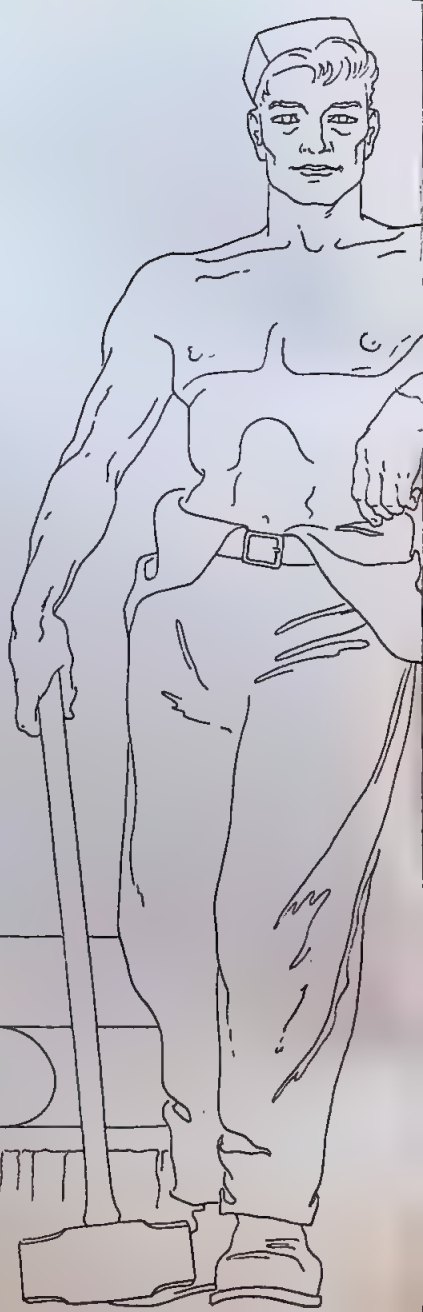
To the south, another railroad line was being driven westward, aiming to draw the growing commerce of the West to its route.

In Pennsylvania, at the time, there was a complicated state transportation system combining canal and rail which had been set up as an offset to these challenges.

However, that system failed to accomplish its purpose, and the business of Philadelphia, then the financial and commercial center of the country, was languishing, as well as that throughout the Commonwealth.

A railroad line across Pennsylvania would enjoy marked advantages, the most notable being the shortest, quickest route to the West.

Responding to public appeal, the State Legislature, on April 13, 1846, passed an act incorporating the Pennsylvania Railroad Company, and a charter was granted shortly thereafter.



WHAT THE CHARTER PROVIDED

The charter authorized the Company to construct a railroad from Harrisburg to

Pittsburgh, a distance of 249 miles. Because there already existed a rail link between Philadelphia and Harrisburg, the railroad's original operation was restricted to service between Harrisburg and Pittsburgh. Not until 1857 did it gain, through purchase, the line to Philadelphia.

On September 1, 1849, the first section to be completed—a distance of 61 miles—was opened for operation between Harrisburg and Lewistown. The time table showed one passenger train over the line each way daily, making the trip in approximately 4 hours. Freight trains ran twice a week.

SWEEPING ON

On February 3, 1852, John Edgar Thomson, the Company's first chief engineer and a railroad man of exceptional ability and vision, was elected President.

Early in his administration, President Thomson pointed out that it was almost as important for the Pennsylvania to invest capital judiciously in railroads being built by others in Ohio and Indiana as it was to provide funds for the completion of the Pennsylvania Railroad itself. By so doing, the Pennsylvania would not only hasten the completion of these railroads but could also perform a greater public service by connecting them to its own line. It is to this early policy that the railroad primarily owes its present form.

Soon thereafter, the Pennsylvania invested substantially in the Ohio and Pennsylvania Railroad, thereby making possible the extension of rail service from Pittsburgh to Crestline, Ohio; then in the Ohio and Indiana Railroad, under construction from Crestline to Fort Wayne, Indiana; and sub-

sequently, in the Fort Wayne and Chicago Railroad. These three lines were ultimately consolidated to form a continuous 468-mile railroad from Pittsburgh to Chicago.

Meantime the all-rail route east of Pittsburgh had been completed, and three trains a day were running between that city and Philadelphia on 13-, 15- and 17-hour schedules. Thus within less than 15 years after the founding of the Pennsylvania Railroad, the country was linked by a solid highway of iron (steel was yet to come) from the Atlantic Seaboard to Chicago and construction was under way on lines to St. Louis, with service ultimately to be provided for Cincinnati, Columbus, Dayton, Cleveland, Buffalo, Detroit, Akron, Youngstown, Indianapolis, Toledo, Grand Rapids, Louisville and all the territory embraced therein. These lines soon were completed and linked to become in time a part of the Pennsylvania Railroad System.

EYES TO THE EAST

As the organization and consolidation of the operation west of Pittsburgh proceeded, the Pennsylvania was also actively expanding its system from Harrisburg to Baltimore and then to Washington—at the same time, reaching northward to important coal and industrial regions. Later, the link between Philadelphia and Baltimore was added.

Above all, though, was the need for through train service between New York and the West under one management. So the Pennsylvania concluded negotiations in 1871 with the railroads operating the lines between Philadelphia and Jersey City for a 999-year lease of those lines, together with their terminal facilities in New York, Jersey City and South Amboy.

For nearly 40 years thereafter the important terminal at Jersey City served as the

From One Passenger Train a Day to 1,340 a Day

In 1848 the Pennsylvania Railroad ordered two passenger cars, one baggage car and two locomotives to inaugurate its first service, which began September 1, 1849. Now, in a single day, 1,340 passenger trains are operated on regular scheduled runs. Today Pennsylvania Railroad passenger service contains every type of equipment for safe travel—all-Pullman trains, all-coach trains, Pullman-and-coach trains.

eastern gateway of the Pennsylvania Railroad, being linked by ferries to New York City itself.

However, as time went on, the Management became convinced that public convenience required the extension of the Pennsylvania Railroad System into and through the City of New York, with a centrally located passenger station in that metropolis. It was recognized that whatever form that project ultimately took, it would be one of great engineering magnitude.

Numerous studies were made and in 1892 a full and comprehensive report was completed outlining various plans, obstacles and possibilities. Ultimately the plans narrowed down to two—bridging the Hudson River or tunneling under it.

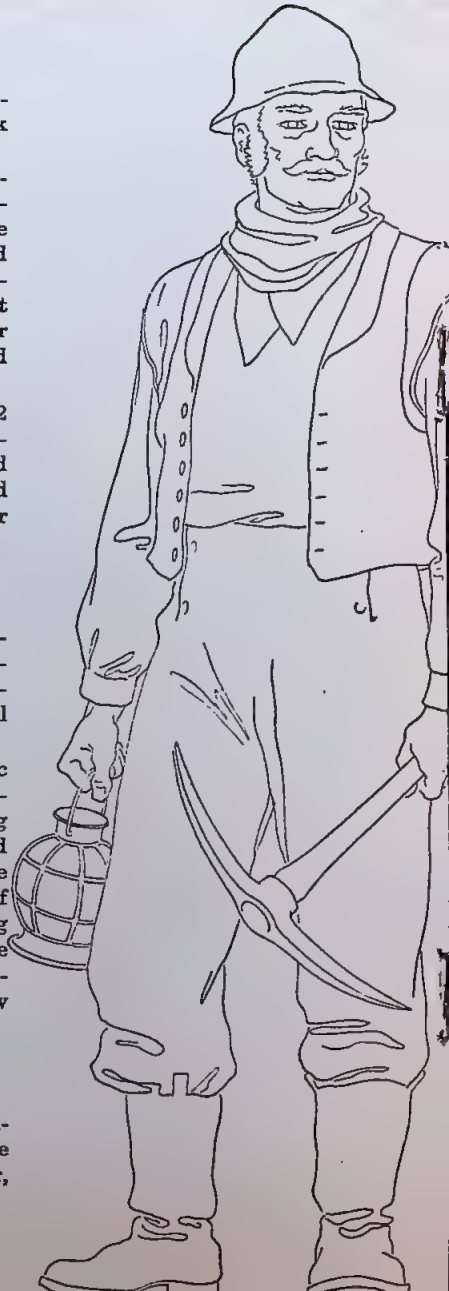
OUTSTANDING ENGINEERS STUDY PLANS

A commission of the most eminent engineers in the country was appointed to determine the better way. Their report recommended tunnels as being more practical and economical.

To provide an even greater range of public service in the New York area, the Pennsylvania acquired in 1900 control of the Long Island Rail Road Company, which operated a system of lines on that island. Thus the railroad's service extended 125 miles east of New York City. Furthermore, by bridging the East River at Hell Gate, through service could be established to and from New England in conjunction with the New York, New Haven & Hartford Railroad.

PENNSYLVANIA STATION, NEW YORK

In 1904, the Pennsylvania awarded contracts for driving two tunnels under the Hudson River and four under the East River,



58% of Freight from Mines

Because the Pennsylvania Railroad System serves the most intensively developed industrial region in the Country, it naturally follows that a large part of its freight is raw materials. This is confirmed by the fact that 58% of the total tonnage moving over the Company's lines in a single year originated in mines. Coal accounted for 41% of Company tonnage. The movement of coal and other minerals is as vital to peacetime industry and home comfort as it was to wartime output.

to reach the vast passenger station to be built at 32nd Street and 7th Avenue, New York.

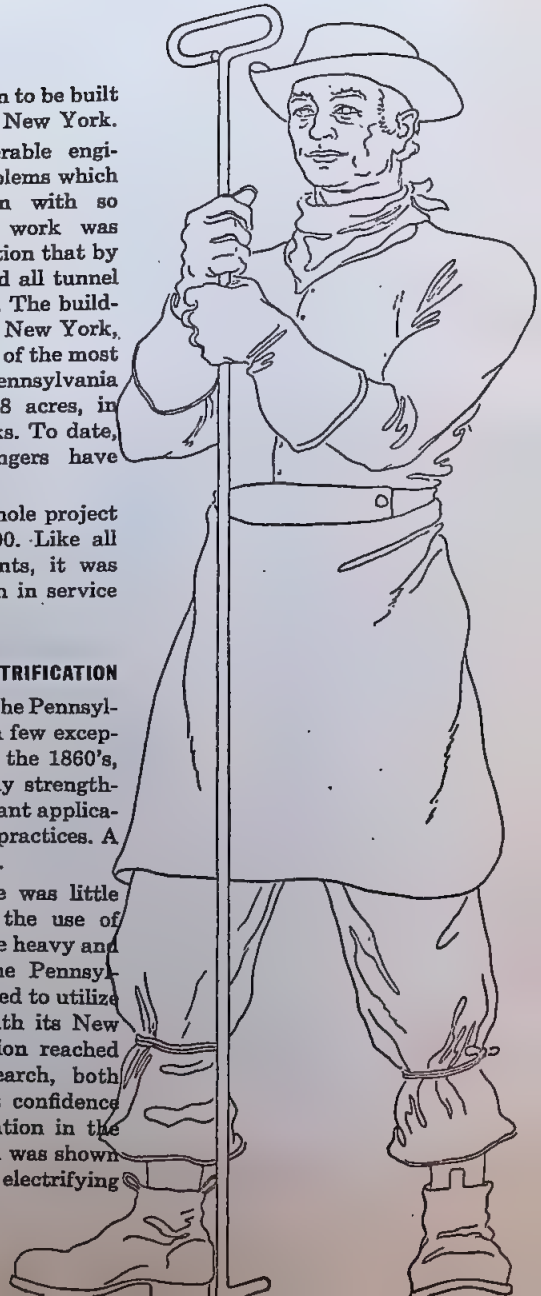
Notwithstanding the innumerable engineering, legal and municipal problems which constantly arose in connection with so gigantic an undertaking, the work was pushed forward with such resolution that by the fall of 1910, the terminal and all tunnel facilities were opened for service. The building of the Pennsylvania Station, New York, and its tunnels is regarded as one of the most epochal achievements of the Pennsylvania Railroad. The station covers 28 acres, in which there are 16 miles of tracks. To date, approximately 2 billion passengers have passed through its train gates.

At the time of opening, the whole project had cost more than $112,000,000. Like all major Pennsylvania improvements, it was designed to provide for a growth in service for many years to come.

ANOTHER FORWARD STEP — ELECTRIFICATION

While the great framework of the Pennsylvania Railroad System was, with few exceptions, established as far back as the 1860's, that framework has been steadily strengthened and broadened by the constant application of modern and far-visioned practices. A notable example is electrification.

As early as 1901, when there was little experience in this Country in the use of electrified motive power to handle heavy and high speed passenger traffic, the Pennsylvania Railroad had already decided to utilize electric energy in connection with its New York tunnel service—a conclusion reached after the most exhaustive research, both here and abroad. The railroad's confidence in the future place of electrification in the scheme of modern transportation was shown in 1902 when it began the work of electrifying



Steel Was the Number 1 War Material

An interesting historical fact is that the steel industry grew out of the iron rail. The Pennsylvania Railroad was the first to supplant iron rail with steel, and thus create a market for steel. Today not only is the Pennsylvania Railroad a steel railroad—cars, locomotives, signals, rail, equipment, structures—but the chief carrier of steel, out of which our Navy and Army weapons of war were built.

the Long Island Rail Road, and thereafter the suburban lines radiating from Philadelphia.

Today—for 194 miles between Harrisburg and New York by one route—and for 226 miles from Washington to New York by another—the great 4-track systems of the Pennsylvania Railroad are completely electrified.

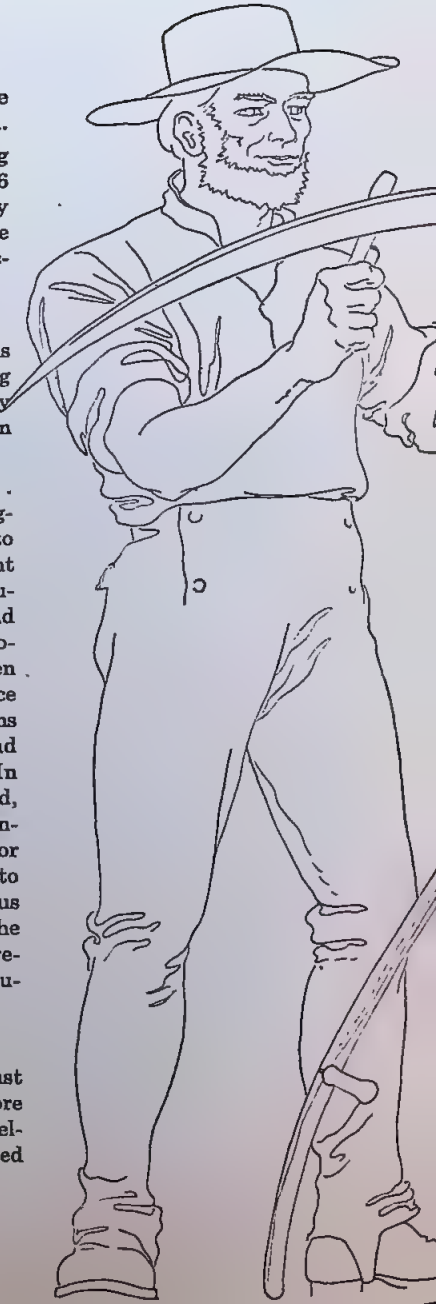
ALWAYS SEARCHING FOR BETTER THINGS

From the beginning the Pennsylvania has been a pioneer in developing and adopting many of the fundamental improvements by which the science of railroading has been advanced.

Noteworthy, among them, have been . . . the steel rail . . . the air brake . . . block signals . . . the application of the telephone to railroading . . . steel cars . . . through freight service, and freight trains operating on regular schedules . . . coordination of truck and train service . . . and the steam turbine locomotive. How farsighted the railroad has been in its realization of the practical importance research must play in improved operations is best illustrated by the Altoona railroad shops, the most extensive in the world. In 1850, before the original line was completed, the railroad began building at Altoona, Pennsylvania, a group of shops—not alone for building and servicing equipment but to promote experiment and development. Thus for 96 years, the Pennsylvania has had the benefit of the most intensive technical research, employing the most modern instruments of science.

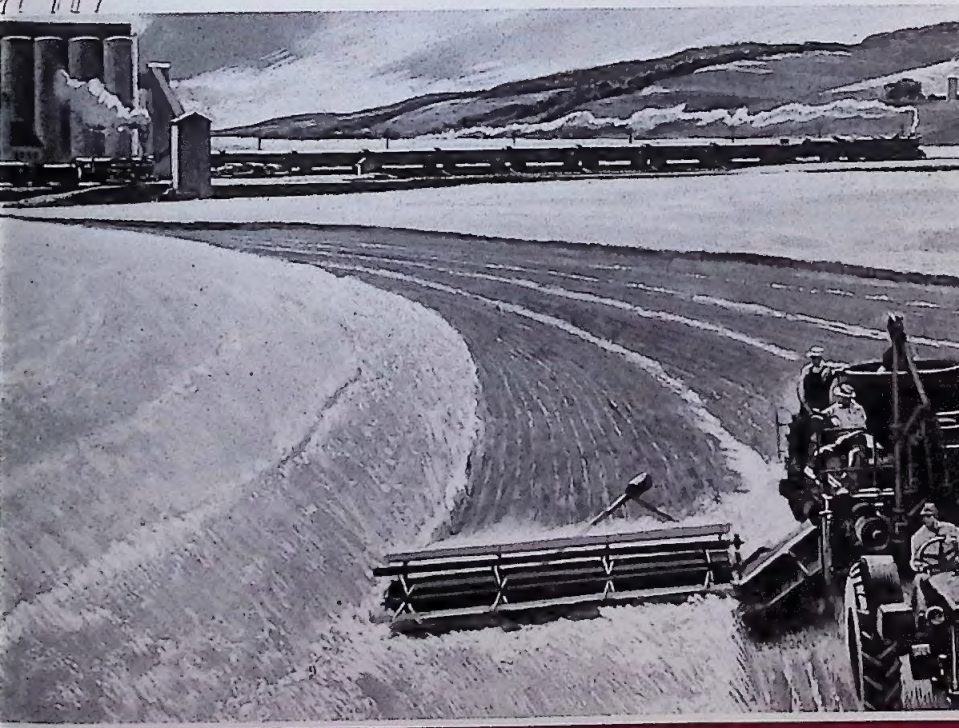
A GLORIOUS MILESTONE

As the railroad looks back over the last century, few of its accomplishments are more noteworthy than its contribution to the welfare and prosperity of those who have placed their faith in it.



For a Century—Working Partner of Agriculture

The big markets for the agriculturist and cattleman are in the region served by the Pennsylvania Railroad. Therefore, from the beginning, farmer and railroad have worked closely together. Last year alone more than 25,000,000 tons from farm, ranch and forest moved over the Pennsylvania Railroad System.



Industry in itself is not an end but a means to an end. Therefore, the objective of the Pennsylvania Railroad Company has been, since its inception, not only to render a continually improving public service but to guide and shape its policies so they would continually produce income for its employes and those who invested their money in its property and services.

As a result, the stockholders have received a cash return in every calendar year since 1847.

The sum total paid to stockholders from 1847 to December 31, 1945, amounts to $1,297,893,025.

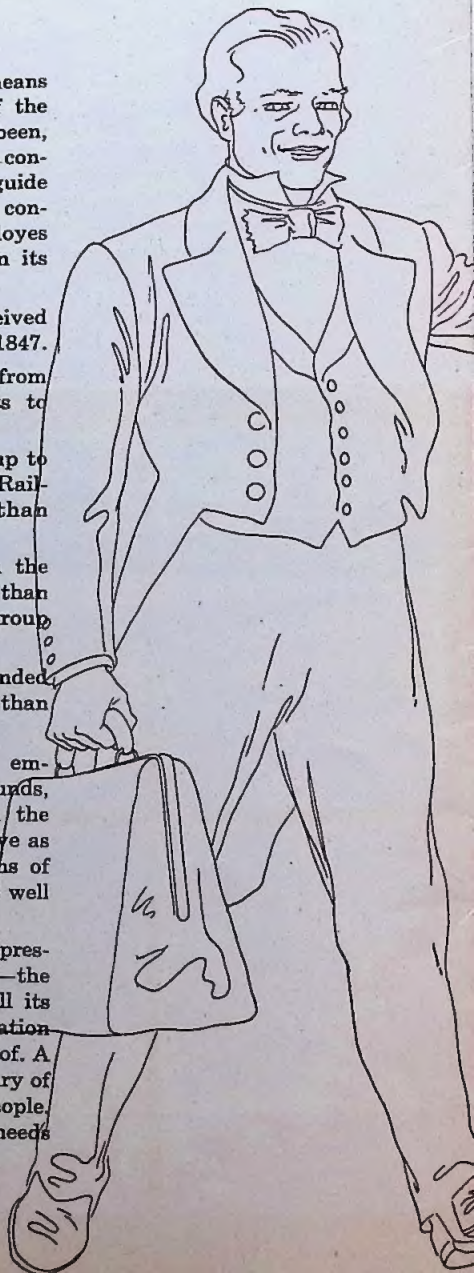
To bondholders over the years, and up to December 31, 1945, the Pennsylvania Railroad Company has paid more than $1,000,000,000 in interest.

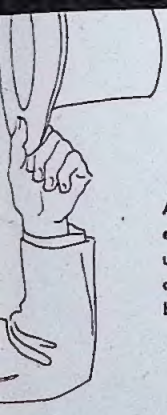
No person is more dependent upon the steady earning power of the railroad than the employe, and to no one person or group has it paid out so much money.

Over the 100 years since it was founded, the Company has paid in wages more than $10,000,000,000.

In addition, ever mindful of the employe's welfare, it has set up relief funds, savings funds, and was a pioneer in the establishment of a pension fund, to serve as practical means of solving the problems of sickness, accident, old age and death as well as to encourage thrift.

Through cycles of prosperity and depression, financial panics, destructive wars—the Pennsylvania Railroad has never in all its history failed to meet a financial obligation when due. That is a record to be proud of. A record to go hand in hand with its century of progressive service to the American people. That spirit carries on, as alert to the needs of the future as throughout the past.

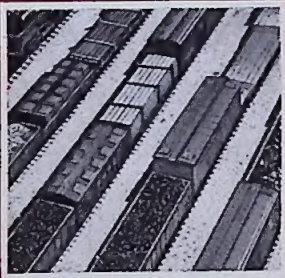




Why Industries Like to be Along Pennsylvania Railroad Lines

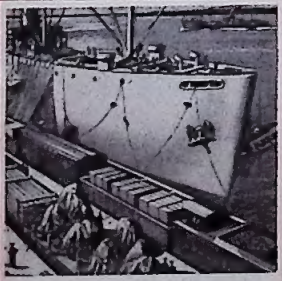
Along lines of the System are approximately 12,000 industrial enterprises, each with its own siding. In addition, there are many thousands more that utilize the System's team tracks and freight stations. More industry is located along the Pennsylvania than along any other railroad. Some—though by no means all—of the reasons for this preference are given below.

IT'S LIKE BEING ON THE MAIN STREET—in a market large and versatile! The market embraces 13 states and the District of Columbia.



SO MANY DIFFERENT TYPES OF CARS and services to handle and speed an industry's products from factory to market.

PICKUP AND DELIVERY SERVICE that is not only extensive, but widely experienced is provided by the Pennsylvania Railroad.



DIRECT SERVICE TO MANY PORTS along the Atlantic Coast; also to principal ports on the Great Lakes.

THROUGH FREIGHT SERVICE by main gateways to and from the West, South, Southwest, New England, Canada and Mexico.

EXCELLENT PASSENGER SERVICE. Customers can quickly and conveniently come to a factory for conferences and inspections.